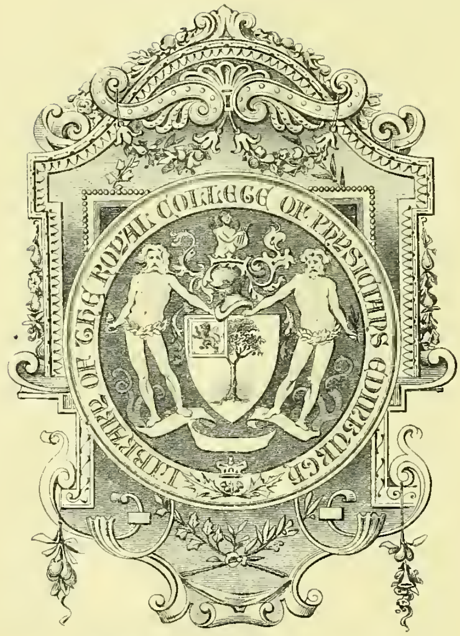

LIBRARY OF THE ROYAL COLLEGE OF PHYSICIANS EDINBURGH

WOOD'S

HOUSEHOLD

PRACTICE OF MEDICINE

HYGIENE AND SURGERY

A PRACTICAL TREATISE FOR THE USE OF
FAMILIES, TRAVELLERS, SEAMEN, MINERS, AND OTHERS

EDITED BY

FREDERICK A. CASTLE, M.D.

IN TWO VOLUMES
ILLUSTRATED BY OVER SEVEN HUNDRED FINE WOOD ENGRAVINGS

VOLUME I.

LONDON
SAMPSON LOW, MARSTON, SEARLE, & RIVINGTON
CROWN BUILDINGS, 188 FLEET STREET
1881

PREFACE.

THE present work has been undertaken with a belief that it is possible to supply to persons having no medical education, such information as will enable them not only to meet emergencies which often arise in the absence of professional advice, but will also help them to understand the nature, course, and results of many diseases, the description of which is not ordinarily to be found outside of technical books, intended for professional readers, and with difficulty understood by others.

It has been heretofore considered inexpedient by physicians to attempt to popularize such knowledge. It seemed difficult to do so, in a way that would enable their writings to be understood by those who know little or nothing of anatomy and physiology, and to whom many things would first require explanation, before the subjects, on which they might desire instruction, could be made comprehensible. Our knowledge of disease was being so rapidly extended that physicians hesitated in expressing opinions, lest they might be misunderstood by those who were unable to appreciate the value of the arguments which supported them. It was also feared that some persons would be tempted to make unwise and improper use of such information.

Of late years, however, the subjects of preventive medicine, as it is called, and of public hygiene, have occupied very largely the attention of physicians; and a far better insight has been gained of the causes of some diseases than we formerly possessed. It has now become the recognized duty of all good physicians to impress

upon the public generally, the importance of appreciating and avoiding these causes, when they are known. It is, therefore, now considered desirable that non-professional persons should have reliable sources of information in relation to disease, in accessible form. To provide this in the best manner, a plan, never before attempted in any popular medical work, has been adopted. The assistance of a number of physicians, eminent as authorities in the matters upon which they write, and well known by their contributions to medical literature, has been secured, and it is believed that the great care taken in the preparation of their several articles will as fully accomplish the purpose as is now possible.

In cases where immediate assistance is demanded; or where a physician must be summoned from a long distance or may be quite inaccessible, and where an intelligent person, with the aid of carefully chosen instructions, may be able to save life or avoid unnecessary suffering, the directions contained herein will be found practically useful. Attention has likewise been given to those minor affections for which it is seldom thought desirable to consult a physician. Other matters have been treated of in such a way as to enable the patient or his friends to cooperate with a physician, so as to secure a rapid recovery or render incurable maladies as little burdensome as possible. In some instances material has been added with a view to imparting general information rather than with a belief that it can be made of practical usefulness without professional aid. This, it is hoped, may sometimes prevent patients from being subjected, through ignorance, to wrong treatment by incompetent or designing persons, as well as convey trustworthy instruction respecting the true nature of certain diseases, about which there is at present but little popularly known.

It must be remembered, that the judgment of a physician may suggest measures and remedies not mentioned in this work; and that as no two persons exactly resemble each other, so no two cases of the same disease present exactly similar symptoms, follow precisely a similar course, or always demand the same measures for their relief. The success of treatment often depends chiefly upon a correct understanding of the causes of a disease,

the surrounding circumstances which may influence it, and the changes in the body produced by it.

In proportion as medical science has advanced, new terms and modes of expression have arisen and been adopted, which are peculiar to the subjects to which they relate and for which there exist few or no corresponding words or phrases in popular use. The occasional employment of some of these is almost unavoidable ; but to remedy this full explanations have been given, either in the text, or in a glossary at the close of the second volume.

The first volume will be found to contain such subjects as—Anatomy, Physiology, Hygiene, the general consideration of the Nature of Diseases, and of the methods commonly pursued for their prevention or relief. It is desirable these should be understood before the maladies affecting special portions of the body are considered. To these are added sections relating to Midwifery ; the Care of Infants, and to some of the diseases more or less peculiar to the earlier years of life. Then follow chapters upon Surgical Accidents and Emergencies, and the nature and antidotes of Poisons.

The second volume is devoted to a description of the diseases of the various portions of the body, classified according to the regions or special organs affected, as this method has the advantage over alphabetical arrangements, that it avoids much repetition and reference to other parts of the work, and enables the writers to express themselves with less restraint. Chapters follow upon diseases affecting the system generally ; information about the Drugs and Remedies in common use ; a section on Nursing, which is intended to embrace more explicit directions upon this topic than are to be found in other portions of the work ; a Glossary defining medical terms commonly used among physicians, and the customary Index to both volumes.

The Editor is solely responsible for all matter included between brackets—[ ].

F. A. C.

NEW YORK, December, 1879.

CONTENTS OF VOL. I.

ANATOMY AND PHYSIOLOGY.

By LEROY MILTON YALE, A.M., M.D.

Page

INTRODUCTION, ... 3
The tissues: protoplasm, connective, fibrous, 4.—Cartilage, bone, epithelium, 6.—Serous, synovial and mucous membranes, 8.—Pigment, 9.

THE BONES, ... 12
General structure, 12.—The spine, 13.—The head, 16.—The chest, 18.—The upper extremities, 20.—The lower extremities, 23.

THE JOINTS, ... 28
General description; ligaments, 28.—Special joints, 29.

THE MUSCLES, ... 30
Voluntary muscles, 30.—Varieties of muscles, 31.—Muscles of the head and face, 32.—Muscles of the trunk, 33.—Muscles of the abdomen, 35.—Muscles of the chest and of respiration, 37.—Muscles of the upper extremities, 38.—Muscles of the lower extremities, 43.

THE ARTERIAL SYSTEM, ... 48
General description, 48.—The aorta and its branches, 49.—Arteries of the upper extremities, 51.—Arteries of the chest and abdomen, 53.—Arteries of the lower extremities, 54.

THE VENOUS SYSTEM, ... 56
General structure of veins, 56.—Veins of the head, 57.—Veins of the upper extremities; veins of the lower extremities, 58.—Veins of the chest and abdomen, 59.

THE HEART, ... 62
Structure of the heart, 62.—Action of the heart, 64.—Course of the blood in the heart and vessels, 66.—The constituents of the blood, 67.

THE RESPIRATORY APPARATUS, ... 69
The larynx, 69.—The wind-pipe or trachea, 70.—The lungs, 71.—Respiration, 72.

Page

THE LYMPHATIC SYSTEM, ... 73

THE NERVOUS SYSTEM, ... 74
General description; nerve-fibres, 74.—Nerve-cells, 75.—The spinal cord, 76. —The Brain, 79.—Medulla oblongata, 81.—Nerves of the head, 82.—The spinal nerves, 84.—The sympathetic system, 86.

THE DIGESTIVE APPARATUS, ... 87
General description; the mouth, 87.—The tongue, 88.—Œsophagus or gullet; the stomach, 89.—The small intestine, 91.—The pancreas, 92.—The liver, 93.—The large intestine, 95.—The peritoneum, 98.

GLANDS WITHOUT DUCTS, ... 98

HYGIENE—FOOD AND AIR.

BY EDWARD H. JANES, M.D.

FOOD, ... 101
General considerations, 101.—Constituents of food, 102.

ANIMAL FOOD, ... 111
General nature of animal food.—Milk, 111.—Butter, 116.—Cheese, 117.—Eggs, meat, 118.—Beef, 119.—Veal; mutton, 120.—Lamb; goat's flesh; pork, 121.—Game; poultry; fish; shell-fish, 123.

VEGETABLE FOOD, ... 124
Wheat, 124.—Rye; buckwheat, 125.—Indian corn; oats; rice, 126.—Barley, beans; peas; potato, 127.—Other vegetables; fruits; mushrooms, 128.—Truffles, 129.

CONDIMENTS. 129

BEVERAGES, ... 130
Tea, 130.—Coffee, 132.—Cocoa, 133.—Maté, 135.

ALCOHOL AS FOOD, ... 136

GENERAL REMARKS, ... 138

AIR IN ITS HYGIENIC RELATIONS.

THE NATURE OF AIR, ... 142

PHYSICAL PROPERTIES OF AIR, ... 143

CONSTITUENTS OF AIR, ... 146
Oxygen, 146.—Nitrogen, 147.—Watery vapor, 148.—Carbonic acid, 150.—Ammonia; ozone, 153.—Carbonic oxide, 154.—Sulphuretted hydrogen; various gases; mineral substances, 156.—Organic matter, 157.

Page

Purification of Air, ... 158
Charcoal, lime, 158.—Permanganate of potassium; nitrate of lead, etc., 159.—Ozone, 160.—Chlorine; iodine and bromine; nitrous and sulphurous acids, carbolic acid; acetic acid, 161.

Disinfection of Empty Rooms, ... 161

Ventilation, ... 162

HYGIENE—DRAINAGE, SEWERAGE, AND WATER-SUPPLY.

By JOHN W. PINKHAM, A.B., M.D.

Drainage, ... 167

Sewerage, ... 171
Water-closets, 174.—House-sewers; privies, 179.—Cesspools, 182.—Clean soil, 185.

Water-Supply, ... 188
Wells, 191.—Cisterns, 197.—Water from streams, ponds and marshes; purification of water, 199.—Water-pipes; examination of water, 202.

HYGIENE—CLOTHING.

By JOHN V. SHOEMAKER, A.M., M.D.

General nature and purposes of clothing, 209.—Distinctive properties of different materials in common use, 210.—Summer clothing, 214.—Winter clothing; tight clothing, 215.—Coverings for the head, 218.—Wet clothing; wind- and rain-proof clothing, 221.—Fire-proof clothing, 222.

HYGIENE—CLIMATE.

By ARTHUR H. NICHOLS, M.D.

Temperature, 225.—Equability; geological character of the soil, 227.—Forests, 228.—Ozone; elevation, 230.—Winds; influence of climate in disease, 232.—Varieties of climate, 235.

HYGIENE—EXERCISE.

By JOHN V. SHOEMAKER, A.M., M.D.

Page

General considerations, 245.—Nature of various forms of exercise, 246.—Gymnastics, 247.—Riding; velocipede-riding; walking, 251.—Rowing, 252.—Swimming; surf bathing, 253.—Sparring, 254.—Time for exercise, 255.—Exercise for invalids; massage, 256.—Swedish movement system; mental exercise, 257.

HYGIENE—HOUSE-BUILDING.

By CARL PFEIFFER, Architect.

Healthfulness of Site, ... 261

Ventilation and Heating, ... 265

Cooling, ... 276

Sunlight, ... 282

Employment of Good Mechanics, ... 283

DISEASE: ITS NATURE, CAUSES, AND MANIFESTATIONS.

By HENRY HARTSHORNE, A.M., M.D.

Local Disorders, ... 288

Irritation; congestion, 288.—Inflammation, 289.—Hypertrophy; atrophy, 290.—Degeneration; effusion or dropsy, 291.—Mortification; gangrene, 292.—Morbid growths, 293.

General Disorders, ... 294

Fever, 294.—Depression; exhaustion; prostration, etc., 295.—Anæmia; leukæmia; 296.—Plethora, cachexia, 297.—Toxæmia or blood-poisoning, 299.

Classification of Diseases, ... 301

Course of Diseases, ... 302

Causation of Diseases, ... 303

Signs of Disease, ... 306

Symptoms affecting the circulation, 307.—Symptoms affecting the breathing organs, 309.—Symptoms presented by the tongue, mouth, etc., 311.—Sickness of stomach and vomiting, 312.—Symptoms afforded by the skin, 313.—Symptoms affecting the bowels, 314.—Urinary symptoms, 315.—Muscular symptoms, 317.—Nervous symptoms, 318.—Symptoms afforded by the eyes and ears, 320.

Page

Physical Diagnosis, ... 320
Inspection; measurement, 320.—Touch; percussion, 321.—Auscultation, 322.

Special Instruments for Diagnosis, ... 325
Thermometer, 325.—Opthalmoscope; otoscope; endoscope; laryngoscope, 326.—Rhinoscope; sphygmograph, 327.—Aspirator, 328.—Microscope; spirometer, dynamometer, 329.—Æsthesiometer, 330.

THERAPEUTICS: OR, THE MODES OF EMPLOYING REMEDIES.

By RICHARD J. DUNGLISON, A.M., M.D.

Definition and General Remarks, ... 333

The Circumstances which Modify the Action of Medicines, . . . 333
Age, 333.—Sex; climate; occupation and habit, 335.—Mental influence; temperament and peculiarities, 336.

Discovery of the Properties of Medicines, ... 337

Parts to which Medicines are Applied, ... 338
Hypodermic medication or injection, 338.—Through the mucous membranes, 339.—Infusion, transfusion, 340.

General Systems of Treatment, ... 340
Homœopathy, 341.—Thomsonianism; eclecticism or eclectic medicine, 343.

Special Modes of Treatment, ... 343
Expectant treatment; specifics; dietetic treatment, 344.—Milk-cure, 345.—Buttermilk-cure; koumiss-cure, 346.—Whey-cure; hunger-cure, 347.—Grape-cure; water-cure, 348.

Baths, ... 352
Hot and warm-water baths, 352.—Vapor baths; Russian baths; Turkish baths, 353.—Mud baths; sand baths, 354.—Mercurial vapor baths; compressed air baths, 355.

Medical Gymnastics, ... 356
Movement-cure, 356.

Counter-Irritation, ... 358
Acupuncture; electropuncture; Baunscheidtism; aquapuncture, 358.—Rubefacients; blisters, 359.

Stimulants, ... 359

Remedies which Modify Nutrition, ... 360

Anæsthetics, ... 361

Antiphlogistics, ... 363

Antiseptics and Antiferments, ... 365

Page
Remedies which Influence the Functions of Vital Organs, ... 366

Electricity and Magnetism, ... 367

MINERAL SPRINGS.

By GEORGE E. WALTON, A.M., M.D.

Composition, ... 372

Classification, ... 373
Alkaline waters, 373.—Saline waters, 374.—Sulphur waters, 375.—Chalybeate waters, 377.—Purgative waters, 378.—Calcic waters, 379.—Thermal waters, 380.

Diseases that may be Treated with Mineral Waters, ... 381

Miscellaneous Observations, ... 386

OBSTETRICS; OR, THE ART OF MIDWIFERY.

By THEOPHILUS PARVIN, A.M., M.D., LL.D.

Anatomy and Physiology of Pregnancy and Parturition, ... 389
Signs of pregnancy, 398.

Hygiene of Pregnancy, ... 402

The Termination of Pregnancy, ... 404
Management of labor, 408.—Management of the child, 413.—Care of the breasts, 423.—Apparent death, 427.

Diseases of the Pregnant State, ... 428
Morning-sickness, 428.—Constipation; diarrhœa; salivation; piles, 429.—Enlarged veins; swelling of the lower limbs; difficulty of breathing; fainting, 430.—Neuralgia, 431.—Discharges from the vagina; itching or irritation of the external organs of generation, 432.—Disorders of the bladder and urine; and uterine displacements; miscellaneous derangements; abortion and miscarriage, 433.—Premature labor; molar or false pregnancy, 436.—Flooding; death of the fœtus; twins, 437.—Protuberant abdomen or large belly, 439.—Sterility, 440.

THE CARE OF INFANTS IN HEALTH.

By BEVERLY ROBINSON, A.M., M.D.

General Hygiene of Infants, ... 445
Clothing, 445.—Temperature of the nursery, 447.—Baths, 448.—Sleep, 450.—Exposure to air, and promenades, 453.—Action of the bowel and bladder,

Page

456.—Period of milk-feeding, 457.—Maternal nursing; rules for raising infants at the breast, 459.—Mixed nursing, 461.—Weaning, 462.—Regimen of nursing mothers, 463.—Wet-nursing, 465.—Feeding with the milk of animals; artificial feeding, 467.

THE CARE OF FEEBLE INFANTS, ... 470
Food, 472.—Air; heat, 473.—Cleanliness, 474.

DISEASES OF THE DIGESTIVE ORGANS IN INFANCY AND CHILDHOOD.

BY J. LEWIS SMITH, M.D.

PHYSIOLOGICAL PECULIARITIES OF INFANTILE DIGESTION, ... 477

SYMPTOMS CONNECTED WITH DERANGEMENT OF THE DIGESTIVE ORGANS, . 479
Vomiting, 479.—Pains in the bowels, 481.—The cry of infants, 483.—Red gum or strophulus, 484.

DISEASES, ... 485
Simple inflammation of the surface of the mouth, 485.—Ulcerous inflammation or ulcerous stomatitis, 486.—Follicular inflammation of the surface of the mouth, 487.—Sprue or thrush, 488.—Gangrene of the mouth, 489.—Teething or dentition, 491.—Indigestion, 495.

DIARRHŒAL MALADIES, ... 501
Simple diarrhœa, 501.—Inflammatory diarrhœa; intestinal catarrh, 503.—Constipation, 513.—Intestinal worms, 515.—Intussusception, 527.

THE NERVOUS DISEASES OF INFANCY AND CHILDHOOD.

BY MARY PUTNAM-JACOBI, PH.G., M.D.

ANATOMY AND PHYSIOLOGY, ... 533

GENERAL CHARACTERISTICS OF THE NERVOUS DISEASES OF INFANCY, . . 535

CONGENITAL DISEASES, ... 542
Absence or deficiency of the brain, 542.—Water in the brain or hydrocephalus, 543.—Arrest of development of the brain, 544.—Want of power of speech; rigidity of the limbs, 545.—Absence of spinal cord; fissure of the spine or spina bifida, 546.—Bleeding into the spinal cord; tetanus of the newly-born, 558.

Page

Non-congenital Diseases, ... 549

Brain fever or meningitis, 550.—Symptoms of inflammation of the brain, 551.—Simple congestion of the brain; rachitic congestion of the brain, 555.—Spurious hydrocephalus, 556.—Bleeding or hemorrhage into the brain, 557.—Tumors of the brain, 558.—Hardening or sclerosis of the brain, 559.

Diseases of the Spinal Cord, ... 559

Acute inflammation of the spinal cord; infantile paralysis, 559.—Hardening or sclerosis of the spinal cord; paralysis from rickets, 562.

Functional Diseases. 563

Paralysis of the muscles of the face, 563.—Paralysis of the palate; false croup or spasm of the glottis, 564.—Convulsions, 566.—Epilepsy, 568.—Tetanie, 570.—Saint Vitus' dance or chorea, 572.—Epidemic chorea, 573.—Hysteria, 574.—Night-terrors, 577.—Night-walking or somnambulism, 581.

ACCIDENTS AND EMERGENCIES.

By ALPHEUS B. CROSBY, A.M., M.D.; ALBERT H. CROSBY, A.M., M.D.; and JOHN T. HODGEN, M.D.

General Remarks, ... 587

Shock, ... 587

Fainting, ... 589

Bleeding, ... 590

Bleeding from the nose, 591.—Bleeding from wounds of the limbs, 592.—Bleeding from the mouth and bowel, 593.—Bleeding from wounds of the head and trunk, 595.

Wounds, ... 597

Cuts. 598.—Punctured wounds, 602.—Lacerated or contused wounds, 605.—Contused wounds, 609.—Poisoned wounds, 611.—Putrefying animal matter, 612.—Stings and bites of insects, 615.—Scorpion and centipede bites, 620.—Snake-bites, 622.—Bites of domestic animals, 627.

Transportation of Sick and Injured Persons, ... 630

Fractures, ... 635

General considerations, 635.—Bandages, 641; dressings for fractures, 641.—Plaster-of-Paris dressings, 643.—Extension; special apparatus; treatment of compound fracture, 644.—Complicating diseases, 645.

Page

SPECIAL FRACTURES, ... 648

Fracture of the nose, 648.—Fracture of the cheek-bones and upper jaw, 649.—Fracture of the lower jaw, 650.—Fractures of the collar-bone or clavicle, 651.—Fracture of the body of the shoulder-blade or scapula; fracture of the acromion process of the shoulder-blade, 655.—Fractures of the upper end of the arm-bone or humerus, 656.—Fracture of the shaft of the humerus or upper arm-bone, 659.—Fractures of the humerus near the elbow, 660.—Fracture of the bones of the forearm near the elbow, 661.—Fracture of the shaft of one or both bones of forearm, 663.—Fractures of the arm near the wrist, 664.—Fractures of the bones of the hand, 666.—Fractures of the fingers, 667.—Fractures of the breast-bone and ribs, 668.—Fractures of the hip-bone, 669.—Fractures of the neck of the thigh-bone, 670.—Fractures of the shaft of the thigh-bone, 674.—Non-union of bones after fracture, 682.—Fracture-beds, 683.—Bad union; fracture just above the knee, 685.—Fractures of the knee-pan, 686.—Fracture of the bones of the leg, 689.—Fracture of the bones of the foot, 700.—Injuries of the head, 701.

DISLOCATIONS, ... 705

General considerations, 705.—Diagnosis, or how to detect a dislocation, 607.—General treatment of dislocations, 708.

PARTICULAR DISLOCATIONS, ... 711

Dislocation of the lower jaw, 711.—Dislocations of the spine, 714.—Dislocations of the shoulder-blade or scapula, 716.—Dislocations of the head of the shoulder or humerus, 717.—Dislocations of the elbow, 723.—Dislocations of the wrist; dislocations of the thumb, 726.—Dislocations of the fingers; dislocations of the hip, 729.—Dislocation of the semi-lunar cartilages of the knee, 746.—Dislocations of the knee, 747.—Dislocation of the fibula; dislocations of the ankle, 749.—Dislocations of the bones of the foot, 752.

MISCELLANEOUS ACCIDENTS, ... 754

Bruises, 754.—Convulsions, 756.—Smothering; choking; strangling; drowning; hanging, 757.—Revival of still-born infants, 760.—Swallowing foreign bodies; rupture or hernia, 762.—Sprains, 765.—Rupture of veins and aneurisms; injuries of the head, 766.—Apoplexy, 767.—Lightning-stroke, 768.

POISONS: THEIR EFFECTS AND ANTIDOTES.

BY ALBERT H. PRESCOTT, M.D., F.C.S.

GENERAL CONSIDERATIONS, ... 771

POISONING OF THE SURFACE OF THE BODY BY GROWING PLANTS, ... 776

Poison-ivy, 776.—Nettle, 778.

POISONING BY THE STINGS AND BITES OF ANIMALS, ... 778

Stings of insects; bites of serpents, 778.

Page

POISONING INCIDENT TO OCCUPATION, ... 779
Phosphorus poisoning, 779.—Lead poisoning, 780.

POISONING FROM USE OF COSMETICS, ... 781
Hair-dyes and restoratives, 781.

POISONING BY COLORED FABRICS, ... 782
Aniline dyes; American leather-cloth, 784.

POISONOUS PLANTS LIABLE TO BE EATEN, ... 784
Aconite, 784.—Castor-oil seeds; crazy-weed, 786.—Buttercup; darnel, 787.—Ergot, 788.—Fool's parsley, 789.—Foxglove; hellebore, 790.—Hemlock, 791.—Water-hemlock, 792.—Henbane; Indian-turnip, 793.—Jasmine, 794.—Lobelia; mandrake, 795.—Mushroom, 796.—Nightshade, 798.—Bitter-sweet; garden-nightshade, potato-apples, 800.—Privet; oleander, 801.—Poke; spigelia; stramonium, 802.—Virginia creeper; yew; pulsatilla, 804.—Laurel, 805.

METALLIC AND OTHER POISONS LIABLE TO OCCUR IN FOOD, ... 806
Lead in potable water, 806.—Lead and copper in beverages and sealed fruits; lead in enamelled cooking vessels, 807.—Flour poisoned with lead from mill-stones; poisonous colors in confectionery and food; copper-poisoning of pickles and preserved vegetables, and the use of copper cooking utensils, 808.—Poisonous chemicals in sugars and syrups, 810.—Injurious flavoring extracts, 812.

POISONING FROM USE OF INSECTICIDES AND VERMIN-KILLERS, ... 813

POISONING BY PHOSPHORUS MATCHES, ... 814

POISONING BY SAUSAGES, SMOKED AND SALT MEATS, SALT FISH, AND CHEESE, . 816

ACCIDENTAL POISONING BY ARTICLES USED IN MEDICINE, ... 817

Anatomy and Physiology.

BY

LEROY MILTON YALE, A.M., M.D.,

VISITING SURGEON TO BELLEVUE HOSPITAL, LECTURER ADJUNCT UPON ORTHOPEDIC SURGERY
IN BELLEVUE HOSPITAL MEDICAL COLLEGE,
NEW YORK CITY.

ANATOMY AND PHYSIOLOGY.

Some general knowledge of the anatomy and physiology of the human body is essential to the proper understanding of any discussion of the diseases to which man is subject. It is scarcely necessary to say that anything like a complete account of the body would fill volumes. But so much as is needful in a work like the present may be comprised within the limits of a not very lengthy chapter.

In order to give, as briefly as possible, the requisite information we shall first describe the bony frame; then the muscles, the blood-vessels and the other systems into which the structures of the body are usually classified. We shall, as we pass, consider the functions of any parts described. Finally, we shall speak of the arrangement and functions of the various apparatuses in the economy.

A few definitions may be premised with advantage. By a *tissue* in anatomy is meant the intimate structure of a part; tissues are made up of fibres and cells of different kinds arranged in different ways. Thus we shall speak of bone tissue, muscular tissue, connective tissue, etc., meaning not any particular bone or muscle, but the kind of living material which makes up all bones, all muscles, or, in the case of connective tissue, the peculiar meshy substance found beneath the skin, and connecting one organ to another in nearly every part of the body. An *organ* is any part of the body having a definite office to perform; thus the heart and the blood-vessels are organs of circulation, the eye of sight, the muscles of movement, etc., etc. The bones are likewise organs, although their functions are far less striking at first sight. A *system* is the name given to all the organs of one kind when viewed collectively; as the muscular system, the nervous system, etc. An *apparatus* is a collection of organs having a common purpose; as the digestive apparatus, which includes all the organs that help to accomplish the digestion of the food, from the teeth and salivary glands to the stomach and intestines and all the glandular organs connected with them.

The Tissues.—It is now generally considered that all the tissues are developed from cells containing a substance called *protoplasm*, within which is a nucleus, or smaller cell, and which again sometimes contains a nucleolus, or little nucleus.

It will be advantageous to briefly mention the peculiarities of the more important kinds of tissue of the body.

Connective tissue (called also cellular, or areolar tissue) is found in all parts of the body. It is called connective tissue because one of its chief offices seems to be to bind together the various parts and structures of the body; it is called cellular because it is meshy in construction, and, if distended with air or fluid, shows spaces or cavities freely communicating with each other. This areolar tissue has vessels, nerves, etc., but its essential elements are two kinds of *fibrous tissue* called the *white* and the *yellow*. The white is made up of extremely fine wavy fibres, which interlace to a certain extent. (See Figure 1.) The yellow elastic fibrous tissue is made

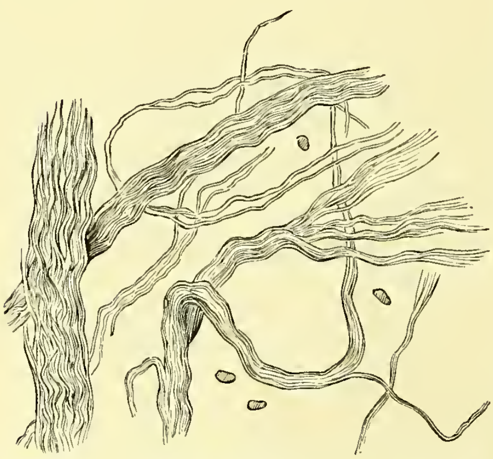


FIGURE 1.—Filaments of areolar or connective tissue, in larger and smaller bundles; magnified 400 diameters.

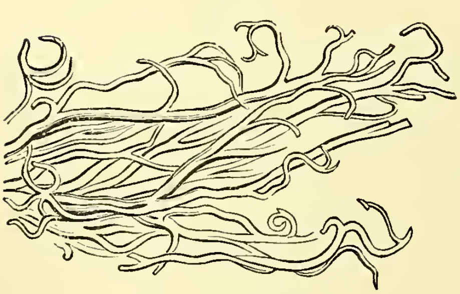


FIG. 2.

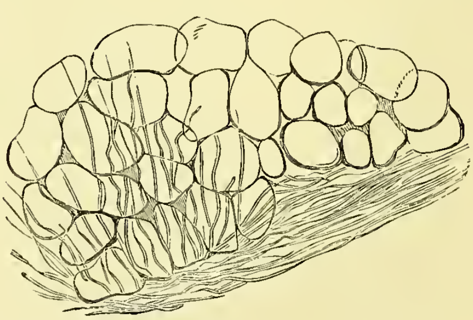


FIG. 3.

FIGURE 2.—Elastic fibres from a ligament; magnified about 200 diameters.
FIGURE 3.—A small cluster of fat-cells; magnified 150 diameters.

up of fibres, considerably larger than those of the white, which branch and join one another. (See Figure 2.) Both kinds of

fibrous tissue are developed from a kind of body which is called a "connective-tissue corpuscle," and which seems to be the origin of a group of tissues.

In connection with the cellular tissue is generally found a certain amount of *adipose tissue*. This consists of vesicles, or little bladders, filled with fat, and held together by the capillary blood-vessels. (See Figure 3.) Both kinds of fibrous tissue are found in nearly every part of the body. The stout sheaths of the muscles (fasciæ), and the covering of the bones (periosteum), for instance, are largely made up of white fibrous tissue with more or less of the yellow elastic tissue. Moreover, some parts, notably one of the ligaments of the spinal column, are very largely composed of the yellow tissue.

The tissue which is popularly called gristle is called by anatomists, *cartilage*. Three varieties of cartilage are found in the human body; the most abundant is the true or hyaline cartilage. This forms the bones in their earliest condition (temporary cartilage), the covering of the ends of bones entering into joints and the cartilages attached to the ribs which make up the front of the chest. This cartilage shows under the microscope certain ovoid cavities called cartilage cavities. These cavities contain from one to twenty cells, according to situation; those near the surface of a joint, for instance, generally have but one. The surrounding substance has very little evidence of structure, and has neither veins nor nerves. In some joints are found fibrous cartilage, which has a fibrous structure with cartilage cells scattered through it. In the ear and larynx is found a yellow cartilage resembling the yellow fibrous tissue.

One of the hardest and strongest tissues of the body is *bone*. It is formed from the primitive temporary cartilage. Into this cartilage blood-vessels find their way, and for their reception everywhere little canals, called *Haversian canals*, are hollowed out. At the same time the cartilage-corpuscles are disappearing, and another kind of bodies, called *bone-corpuscles*, appear instead. These latter are somewhat of the shape of a fennel-seed, with little fibres running out from the sides. In these corpuscles are found bone-cells, but the precise relation of the cell to the corpuscle is still a matter of some dispute. They are the agents by which the lime salts are deposited in the cartilaginous structure. The figure below shows the arrangement of the so-called Haversian systems. In dried bone the sites of the corpuscles are represented by the cavities, called *lacunæ*, from which the corpuscles have been removed. The fine lines around each lacuna are *canaliculi* (*i. e.*, little canals), and in living bone they are thought to contain the

fibrous prolongations of the bone-corpuscle alluded to. (See Fig. 4.) It will be seen that the bone-corpuscles are arranged in concentric circles around the Haversian canal as a centre. The canaliculi of the first row connect with the canal, and in the other direction with the canaliculi of the second row, and so on. In this manner a circulation of the nutritive elements of the blood is secured.

The process of change into bone does not go on all at once, but spreads gradually from certain points in each bone, called "centres of ossification." In the spongy bones and the spongy (cancellated) parts of other bones, the canals and corpuscles have not the concentric arrangement above described; but in the thin plates of bone dividing the cavities of the spongy bone are found canals and bone-corpuscles. Bone is abundantly supplied with blood-vessels and nerves.

The chemical composition of bone is one-third organic matter,

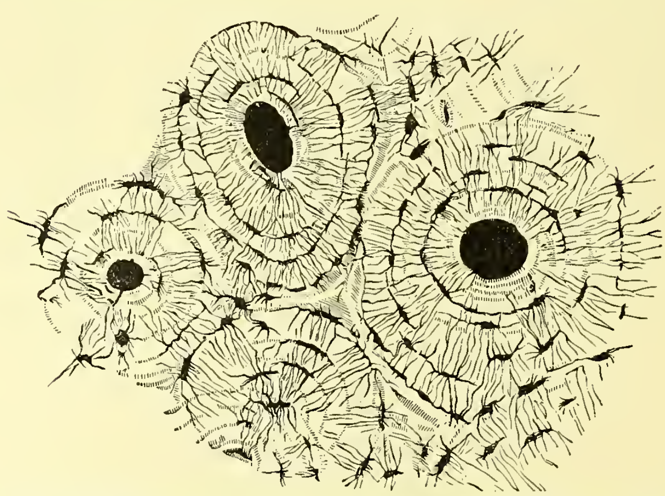


FIGURE 4.—Transverse section of compact bone-tissue, magnified about 150 diameters. Three of the Haversian canals are seen also; the encircling rings, with the corpuscles, and the canaliculi extending from them.

and two-thirds inorganic matter. Of the inorganic matter the greater part (rather more than half the whole weight of the bone) is phosphate of lime; with this is a considerable amount (11.30 per cent.) of carbonate of lime. The remainder is composed of alkaline salts.*

As the expression *epithelium* or *epithelial cells* will be frequenly used in this work, it may be convenient to briefly mention

* For a description of muscular tissue, see page 30.

the peculiarities of these cells and of the membranes upon which they are found. In a general way we may say, all free surfaces of the body or of its cavities are covered with these cells; but their functions vary very widely with their situation. Several varieties of epithelium are described: *Pavement* epithelium consists of

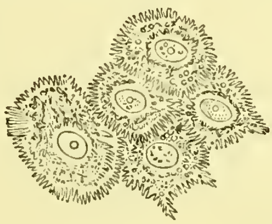


Fig. 5.

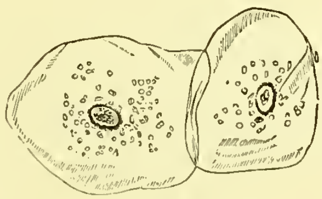
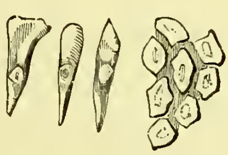


Fig. 6.

Figure 5. — Toothed cells of the human epidermis; about 1-1000 of an inch in diameter.
Figure 6. — Pavement epithelium-cells from the cavity of the mouth; magnified 260 diameters.

flat scales with neuclei. This kind is found very widely distributed throughout the body. Fig. 5 shows epithelium scales from the surface of the skin, these having the special name of epidermis. Fig. 6 shows large pavement scales from the cavity of the mouth.

Columnar epithelium (Figure 7) is made up of cylindrical or conical cells placed side by side, so that their extremities make up the surface of a membrane. The mucous membrane of the intestinal tract and of the urinary organs is chiefly of this variety. In some places *spheroidal* cells are found. When the free surface of



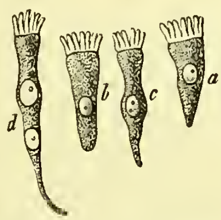


Figure 7. — Columnar epithelium from the mucous membrane of the intestine, largely magnified. The figure on the right is the appearance of a number of cells, as they are naturally grouped together, and seen from above.
Figure 8. — Columnar ciliated epithelium-cells from the mucous membrane of the nose; magnified 300 diameters.

the epithelial cell is furnished with hair-like projections the epithelium is said to be *ciliated* (*cilia*, eye-lashes). (See Fig. 8.) These cilia are in life in continual motion, and are supposed to keep up a current in the liquid secretions of the parts where they are found, as in the respiratory passages.

Epithelium enters into the structure of three kinds of membranes, to be often referred to hereafter. They are the *serous*, *synovial*, and *mucous* membranes. They all have thus much in common: a simple structureless membrane, called a basement membrane, upon which the epithelial layer is supported.

A *serous membrane* is always a shut sac; in general it has a single layer of pavement epithelial cells, then the basement membrane, and below, again, connective tissue, which contains the blood-vessels, from which is derived the secretion of the membrane.

The *synovial membranes* line the cavities of joints, and have so great a similarity to serous membranes, that they were formerly described as such. (See page 28.)

A *secreting gland* is an organ by which some element is separated (secreted) from the blood flowing through its capillary vessels. This definition does not cover the lymphatic glands. Theoretically the structure of a gland is a reduplication of mucous membrane, both the epithelial and basement layers. The cuts below show diagrammatically how this is done; the dotted line represents the epithelial layer; the full line, the basement membrane.

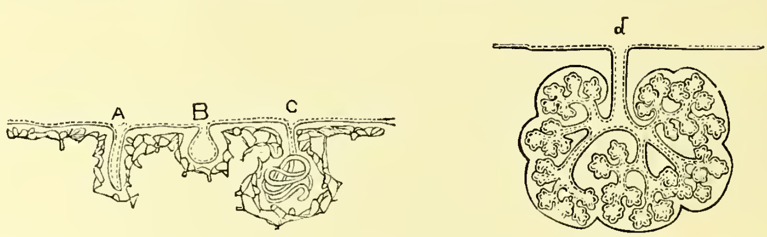


FIGURE 9. — Diagram to show how glands are formed by inversion or recession of the secreting membrane to form cavities: *a*, simple straight tube or follicle; *b*, sac; *c*, coiled tube; *d*, branched-duct and lobules of a "racemose" gland.

A *mucous membrane* may have any variety of epithelium. The basement membrane is reinforced by some fibro-vascular tissue, the whole being styled *corium;* beneath this again is connective tissue. In the deepest portion is often found unstriped muscular tissue, and also some glandular structures.

[The mucous membrane resembles very closely the skin, only modified in such a way as to enable it to subserve its special function, which is to afford a soft, moist, and flexible lining to such cavities and passages of the body as communicate with the external world ; for every cavity or passage of the body which has an external communication is lined with mucous membrane: such as the lungs, intestines, genito-urinary apparatus, etc. In the basement layer we find large number of minute glands with ducts,

which, passing through the surface coat (the epithelial layer), open on the surface of the membrane. These glands discharge a thin fluid (mucus), which serves to lubricate the membrane, keeping it in a soft and pliable condition.

In a healthy mucous membrane the processes which go on are very simple. These little glands pour out mucus on its surface, and at the same time those cells—the epithelial cells—which form the surface-layer are becoming detached and cast off by friction, and by the ordinary process of waste, and at the same time are renewed by new cells being developed from below; so that we have, as the normal healthy secretion or discharge from a mucous membrane, a small quantity of mucus containing more or less worn-out epithelial cells—a transparent fluid of a grayish color and viscid character.

If a mucous membrane, however, becomes inflamed, as a result of taking cold or from a direct injury, for instance, what takes place is much as follows: The blood-vessels which course in the deep layer become very much distended with blood, giving the membrane a red and swollen appearance. The ordinary process of simple growth is very much exaggerated, the little epithelial cells are produced in much larger numbers, and are consequently cast off from the surface in large quantities. The glands, which in health discharge only sufficient mucus to lubricate the membrane, now pour out this fluid in large quantities, so that we have the membrane red, swollen, and discharging a large amount of mucus so filled with the cast-off epithelial cells as to change its character; or, as the inflammation goes on, we have the discharge becoming very much like pus or matter, a yellowish and often offensive fluid. This, of which the common "cold in the head" is the most familiar example, constitutes the simplest form of acute catarrh.]

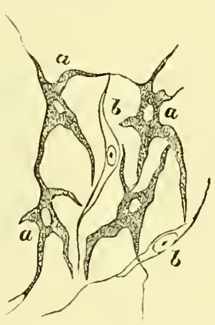


FIGURE 10.—Pigment epithelium cells from the choroid coat of the eye, largely magnified: *a*, cells containing pigment; *b*, spindle-shaped cells without pigment.

In some parts of the body the *pigment* or coloring matter is deposited in the epithelial cells. The exact method of this deposit varies: it is somewhat different, for instance, in the choroid coat of the eye from what is found in the skin (Fig. 10.)

[It is the presence of patches of this coloring matter in the skin of the face and hands which causes "freckles," while a variation in the deeper and more abundant layer causes the difference in the complexion of the skin in the various races.]

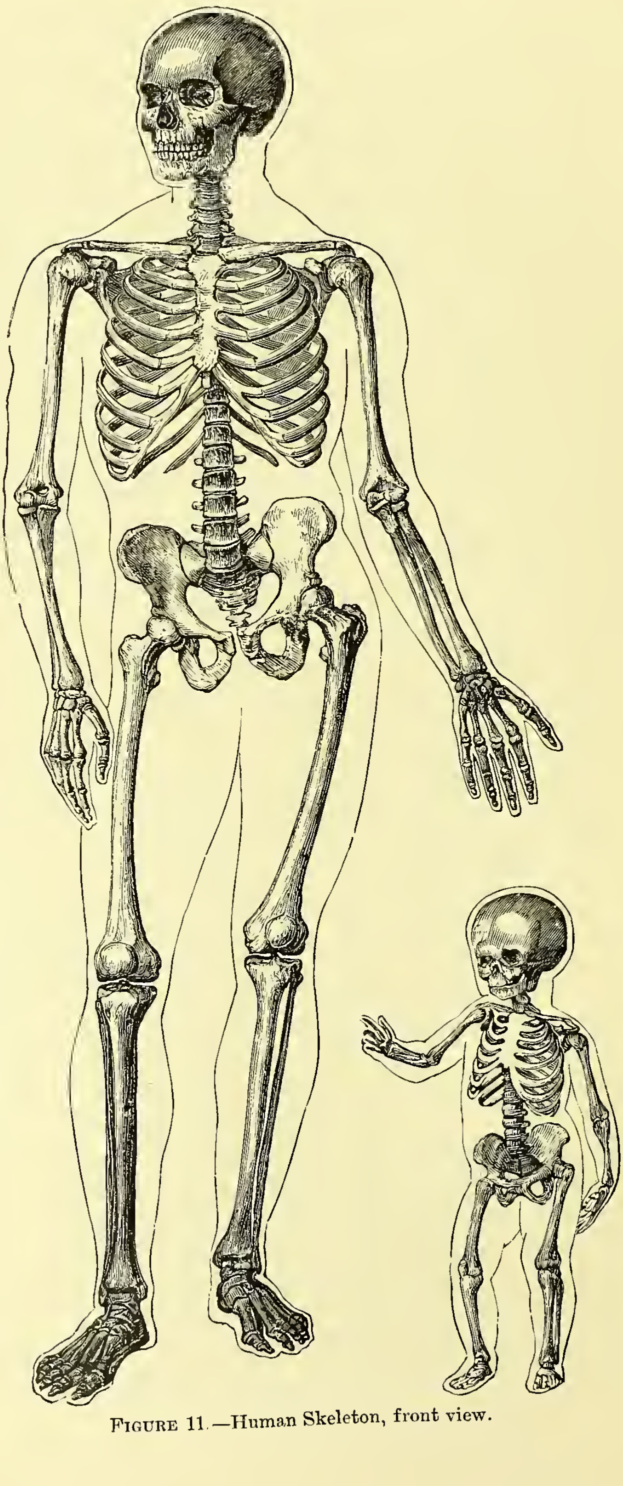


FIGURE 11.—Human Skeleton, front view.

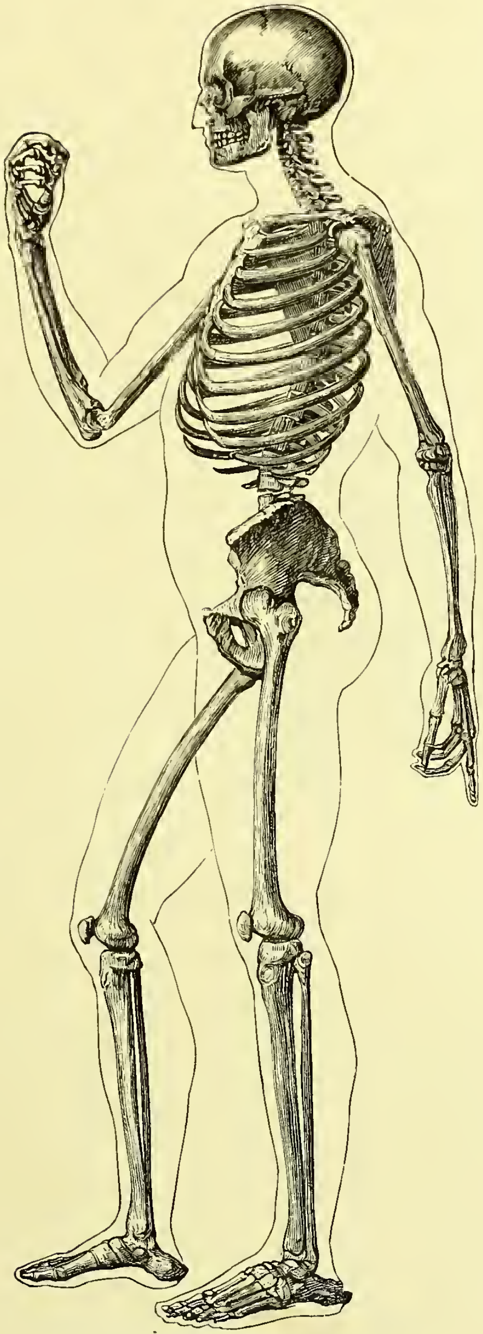


FIGURE 12.—Human Skeleton, side view.

THE BONES.

The great framework of the body is the osseous system, that is, the bones in their aggregate. A bone, as we are accustomed to see it, is a hard, dry, and, if the expression may be allowed, very dead substance. There is little in its appearance to distinguish it from a mineral substance ; largely, indeed, it is mineral. But in the body in health bone is a very different thing. It is hard, to be sure, but it is a living organ. A living bone, or one recently removed from the body is pink exteriorly and red within. The outer part is quite dense, while the inner part is more loose or spongy in appearance, and its structure is said to be *cancellated.* A very casual examination of the bone, however, will show that even its hardest part is quite porous. Some bones possess a relatively large proportion of this hard matter, and others very little ; the variation being generally with relation to the amount of strain likely to be brought upon the particular bone. The arrangement of the bony structure in the spongy portions is not a matter of chance, but is found, upon examination, to have an architectural disposition suited to the pressure it must bear. If bone is considered *chemically*, it is found to consist of organic and inorganic matter. The organic matter is nearly the same as gelatine, into which it can easily be converted. The inorganic matter consists of the salts of lime, magnesium, iron, and sodium ; phosphate and carbonate of lime predominating. But if the bone be considered as an organ, we find it has a peculiar arrangement of parts, which necessarily varies with the shape and needs of each bone. Take a thigh-bone as an example the long shaft is hollow, the bone surrounding the cavity growing more and more dense as the surface is approached. The hard part is traversed by a great number of canals, around which are arranged certain cavities with very fine canals radiating from them. The larger canals, in the living bone, contain blood-vessels, and the cavities contain bone-cells, which are the agents by which

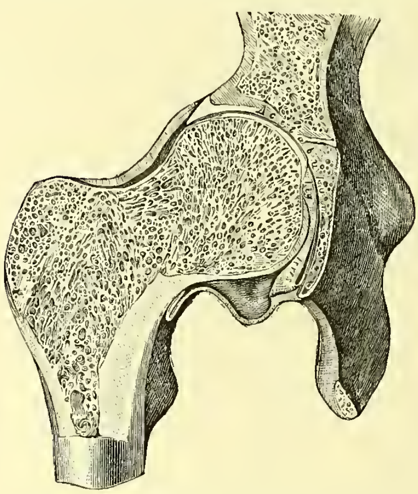


FIGURE 13.—The upper end of a thigh-bone and its socket in the hip-bone, divided so as to show the arrangement of the bony structure.

the lime-salts are deposited in the bone-tissue. The great cavity in the centre of the bone contains the marrow, which has an office in the nourishment of the bone. The extremities of the bone are made up of the spongy bone before spoken of. The surface of the bone, except at the articulating ends, and a few other places, is covered by a nourishing membrane called the periosteum, and the cavity is lined by another called the endosteum. Bones are abundantly supplied with blood-vessels and also with nerves. There are in the human skeleton (exclusive of the teeth, knee-pans, etc.) 204 bones, as follows :

In the spinal column	26
" " skull proper	8
The little bones of the ear	6
In the face	14
Hyoid bone, breast-bone, and ribs	26
The upper extremities	64
" lower "	60

The bones in the earliest periods of life do not have the structure described. The bony skeleton is sketched out, so to speak, in cartilage, the organic matter of the bones. This cartilage is gradually changed into bone, the change going on from certain points as centres. But at birth, and indeed for a long time after, the bones have not yet become perfectly solid. The thigh-bone, already instanced, remains the longest in this unfinished state, the lower end joining the shaft only about the twentieth year. It follows that in children injuries, which in an adult would be likely to break a bone, often result in a separation of the parts that make up a bone.

The Spine.

The spine is described as "a flexuous column, formed of a series of bones called vertebræ." In the vertebral column are seven *cervical* vertebræ, twelve *dorsal*, five *lumbar*, five *sacral*, four *coccygeal;* besides, the bones of the head are considered as making up four vertebræ. The five sacral vertebræ are united into one bone, and the four coccygeal into another, called, respectively, the sacrum and the coccyx.

The essential peculiarities of a vertebra are : a stout body in front and an arch behind. The arch is divided, in description, into pedicles and laminæ, and from the arch arise two transverse processes, two articulating processes, and a spinous process. The

transverse processes serve for the attachment of muscles. The articulating processes connect the vertebra with its fellows above and below. The spinous processes project behind, and serve also for the attachment of muscles.

The vertebræ vary in appearance in different parts of the col-

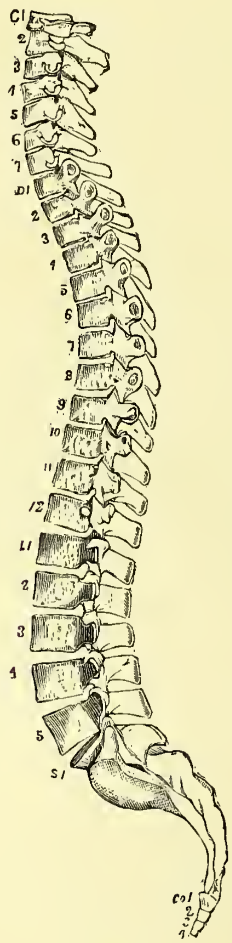


FIG. 14.

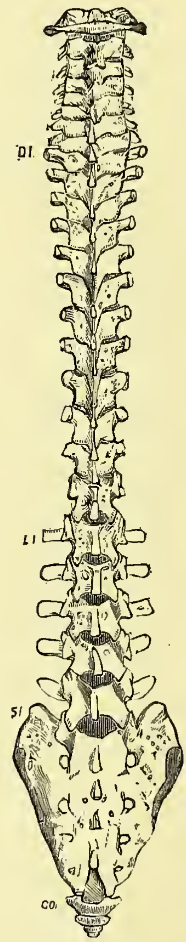


FIG. 15.

FIGURE 14.—The spinal column as seen from the left side. C 1 to 7, the seven cervical vertebræ; D 1 to 12, the twelve dorsal vertebræ; L 1 to 5, the five lumbar vertebræ; S 1, the sacrum; Co 1 to 4, the four bones of the coccyx.
FIGURE 15.—The spinal column as seen from behind.

umn. In a general way the bodies increase in size as we go downward from the neck. In the neck the spinous processes project nearly horizontally, in the dorsal region they slope downward, in

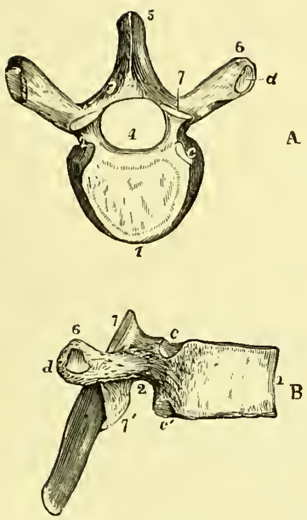


FIG. 16.

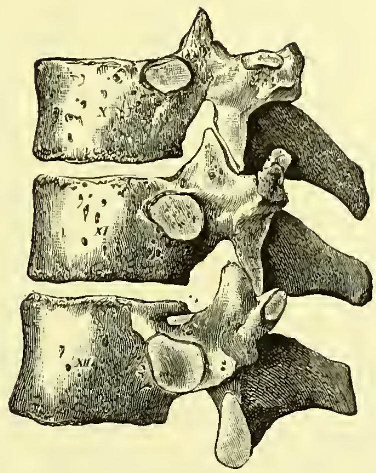


FIG. 17.

FIGURE 16.—A dorsal vertebra seen (A) from above, and (B) from the right side. The letters and figures refer to corresponding parts: 1, the *body* of the vertebra; 2, the notch through which the nerves pass out from the spinal canal. In Fig. A the number rests on the *pedicle*; 3, the *lamina* of the right side; 4, the *spinal foramen*, through which the spinal cord passes; 5, the *spinous process*; 6 the *transverse process*, on the end of which is the surface *d*, which articulates, or is attached to the tubercle of a rib; 7 and 7′, the *articular processes*. These have smooth facets, which connect the vertebra with corresponding processes on the bones above and below; *c* and *c′*, facets on the upper and lower surfaces of the body, for the attachment of the heads of ribs.

FIGURE 17.—The lower three of the dorsal vertebræ, showing the way in which their articular facets are placed.

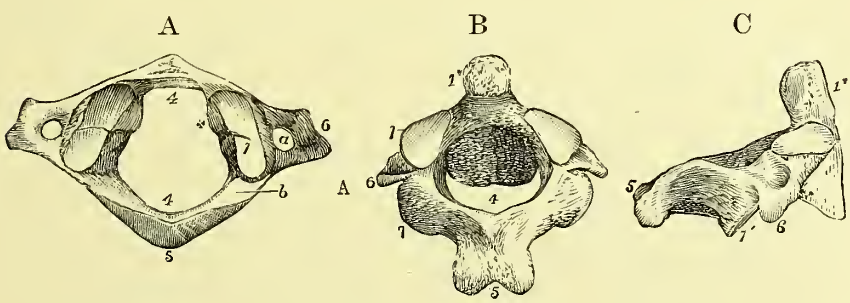


FIGURE 18.—A, the *Atlas*, or first cervical vertebra. B, the *Axis*, or second cervical vertebra, as seen from behind; C, the same bone as seen from the right side. The numbers indicate corresponding portions of each bone: 1, the odontoid, or tooth-like, process of the axis fitting into the depression on the inner side of the atlas at A 4. The * on the inner side of the same bone indicates the attachment, on one side, of the ligament which forms the fourth side of the space and keeps this pivot in place. In executions by hanging it is attempted, by the arrangement of the rope, to cause a forcible rupture of the ligaments holding this pivot in place, and by the displacement backward of the latter to crush the spinal cord at this point, and so produce death; 5, the spinous process; 6, the transverse processes; 7, the *superior* and 7′ the *inferior* articulating processes.

the lumbar region again the spinous processes are very short and stout. Many other variations exist, but they cannot be detailed in a short sketch like the present. Between the bodies of the vertebræ are placed discs of fibro-cartilage, which are quite elastic. The vertebræ are bound together by various ligaments. When the vertebræ are thus placed, one upon another, and held in place by the ligaments, the arches form a continuous canal, which contains the spinal cord.

The first and second vertebræ of the neck are sufficiently curious to deserve especial mention. The first is called the *Atlas*. It is essentially a ring of bone, the body being absent. Its articulating processes above are very large, and support the head and allow free movement of the latter, forward and backward. The second vertebra is called the *Axis*. Its body is prolonged upward about three-fourths of an inch, in fact, the missing body of the first vertebra is combined with that of the second. Around this projection of the body of the axis, as a pivot, the atlas revolves, being kept from slipping by a strong ligament. The movement of turning the head to either side is thus permitted.

The Head.

The bony frame of the head is the skull. The skull is made up of twenty-two bones, but for convenience they are divided into two groups, those of the cranium and those of the face. The cranium is composed of eight bones, the occipital, two parietal, frontal, two temporal, sphenoid and ethmoid. The face has fourteen bones, viz.: the two nasal, two superior maxillary, two lachrymal, two malar, two palate, two inferior turbinated, vomer and inferior maxillary.

The *occipital* bone forms the back part and base of the cranium. It is convex externally, and concave internally, its inner surface being divided by two ridges into four depressions. These ridges afford attachments to strong membranes, known as the falx cerebri and the tentorium cerebelli. The outer surface is also marked by ridges and inequalities which serve for the attachment of muscles steadying and moving the head. At the lower part of the occipital bone is the foramen magnum, an oval aperture about an inch and a half in its greatest diameter, through which the spinal cord passes from the skull to the canal of the spinal column. The occipital bone articulates by the lambdoidal suture with the two parietal bones above, in front with the two temporal and the sphenoid, and below it rests upon the first vertebra, known as the atlas.

The sides of the cranium are made up mainly of the two *parietal bones* that meet in a straight suture (called the sagittal) at the top of the head. These bones are likewise convex without and concave within, but are much smoother on both surfaces than is the occipital bone.

The forehead is formed by the *frontal bone*, which extends from the eyebrows backward to meet the parietal bones before described. Besides this main portion called the vertical portion, it has an horizontal portion extending backward within the skull in such a manner that its under surface forms a roof to the sockets of the eyes beneath, and its upper surface a floor for the support of the anterior lobes of the brain above. This floor is cleft in the centre between the two so-called orbital plates, the notch being filled up by the upper part of the ethmoid bone.

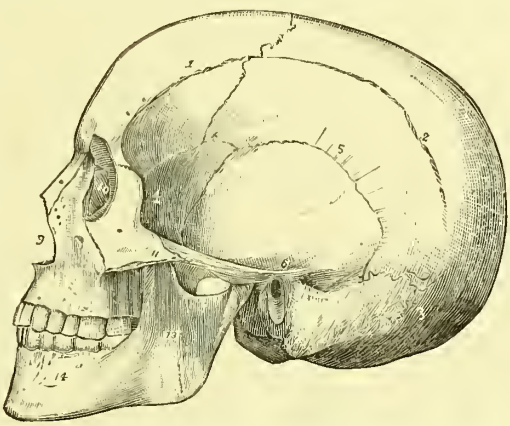


FIGURE 19.—The skull. 1, frontal bone; 2, parietal bone. The line or ridge below these numbers is the outer limit of the origin of the temporal muscle; x, coronal suture uniting the frontal and parietal bones; 3, occipital bone—the figure is placed at the lower end of the lambdoidal suture, uniting the parietal and occipital bones; 4, greater wing of the sphenoid bone; 5 is placed just above the upper edge of the temporal bone as it lies upon the parietal; 6 is on the lower part of the temporal bone where the zygoma joins it; the oval opening a little lower down is the entrance to the bony canal of the ear; 7, mastoid portion of the temporal bone; the pointed projection in front of it is the mastoid process (See Chapter on the Ear); 9, the opening of the nasal cavity; 10, inner wall of the orbit, or the lachrymal bone; 11, the malar bone close to its junction with the zygoma; 12, superior maxillary bone; 13, ramus of the lower jaw; 14, body of the lower jaw.

Below the parietal bones in the part of the skull corresponding to the ear on either side, is a *temporal bone*, so called from the fact that in this part of the head the hair first shows the marks of time. These bones are considerably smaller than those previously described, and are very irregular in contour. The upper part of the external surface is smooth above, but from about its middle runs forward a finger-like projection, called the zygomatic process, which meets and unites with a similar projection on the malar bone. In the lower half of this surface is found a depression for articulation with the lower jaw, and immediately behind it is the opening of the ear. The lower part of the temporal bone contains the organ of hearing.

The *sphenoid* bone is situated at the base of the cranium. Its shape is exceedingly irregular, and can be compared to nothing except a bat with wings extended. It articulates with twelve bones.

The *ethmoid bone* is a spongy bone, quite complicated in structure, situated at the root of the nose, and serves to support the organs of smell.

The fourteen bones of the face are thus situated.

The *nasal* bones form the bridge of the nose.

The *superior maxillary bones* make up the upper jaw. Their upper parts help to form the orbits and the sides of the nose, and a horizontal projection from their inner surfaces form the roof of the mouth or hard palate. Still farther, a projection from the outer surface of each bone unites with the malar bone to form the prominence of the cheek, and this projection is hollow, the cavity being called the antrum of Highmore. The bone is of considerable surgical importance, by reason of the many diseases to which it is subject.

The *malar bones* unite with the upper jaw-bone in front, the temporal bone behind, and above it forms the outer margin of the orbit.

The *palatal bones* are situated within the skull, at the back part of the nasal fossæ, or cavity of the nose.

The *inferior turbinated* bones are situated at the sides of the nasal cavities.

The *vomer* helps to form the partition of the nose.

The *inferior maxillary bone*, or lower jaw, is made up of a semicircular horizontal portion containing the teeth, and an upright portion on either side. This perpendicular part is forked at its upper end, the posterior fork terminating in a rounded head which articulates with the temporal bone, making the joint of the jaw. The anterior fork is pointed, and serves for the attachment of the strong temporal muscle, one of those most powerful in moving the lower jaw.

At the base of the tongue is a small bone called the *hyoid bone*, or the lingual bone. It resembles the letter U in shape, and has its ends or horns turned up at an angle with the body of the bone. It serves as a support to the tongue, and to many muscles in this region.

The Chest.

The thorax, or chest, is a box made up of the bodies of twelve dorsal vertebræ behind, the sternum, or breast-bone, in front, and the ribs with their cartilages, twelve on each side, passing around the sides. The vertebræ have been already sufficiently described.

The *Breast-bone* has been compared in shape to an ancient sword. It is composed of three pieces ; the upper is the manubri-

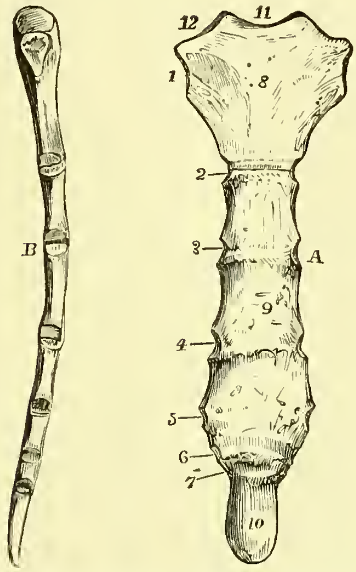


FIGURE 20.—The sternum, or breastbone: A, the bone as seen from the front; 1 to 7, point to where the costal, or rib cartilages, are attached; 8, manubrium; 9, body, or gladiolus; 10, ensiform cartilage; 11, the notch seen between the ends of the collar-bones; 12, place where the right clavicle or collar-bone is attached; B, the right edge of the sternum.

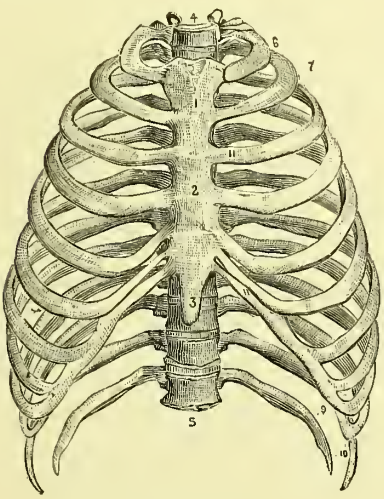


FIG. 21.

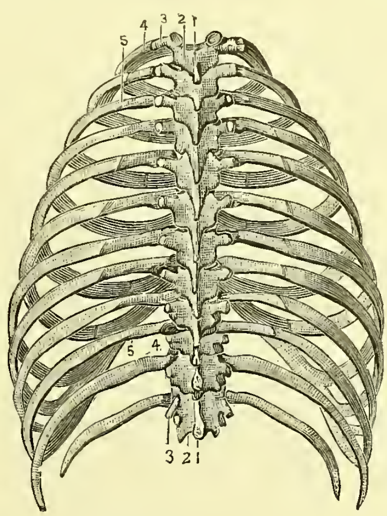


FIG. 22.

FIGURE 21.—Front view of the bones of the chest: 1, the manubrium of the sternum, or breastbone; 2, body of the sternum; 3, ensiform cartilage; 4, first dorsal vertebra; 5, twelfth dorsal vertebra; 6 and 7 are opposite the first and second ribs on the left side; 9 and 10, false, or floating ribs, which have no cartilaginous connection with the breast-bone; 11, 11, are placed over two of the costal cartilages.

FIGURE 22.—The bones of the thorax, seen from behind: 1, 1, the spinous processes of the first and twelfth dorsal vertebræ; 2, 2, laminæ of the same vertebræ; 3, 3, transverse processes of the vertebræ; 4, 4, points where the first and tenth ribs articulate with corresponding transverse processes of vertebræ; 5, angle of the third rib.

um, or handle, the second the gladiolus, or blade, the third the ensiform (sword-like) appendix.

The *Ribs* are twenty-four in number, twelve on a side. They are all jointed to the back-bone, and the upper seven on each side are connected by their cartilages to the breast-bone. These are called *true* ribs, the other five *false* ribs. The upper three false ribs are connected in front by their cartilages to the cartilages above ; the lower two are connected to the spinal column only, and are called floating ribs. The ribs vary much in appearance in passing from the top to the bottom of the chest. Taking one from the middle of the chest as an example it would be found to be irregularly semicircular in shape, twisted slightly upon itself. The part that joins the back-bone is called the head, the narrowing near it the neck, the remainder the shaft. The point of most sudden curve is called the angle. The direction of the ribs is obliquely downward and forward, the obliquity increasing from above downward.

The cartilages of the ribs are attached to the ends of the ribs and to the breast-bone in the manner above mentioned. Their office is to facilitate the movements of the chest

The Upper Extremity.

The upper extremity consists of the arm, the forearm, and the hand, and with it are generally described the bones of the shoulder, namely, the clavicle, or collar-bone, and the scapula, or shoulder-blade.

The *collar-bone* is a long bone, curved in such a manner that it is often compared to an italic letter *f*. Its inner extremity articulates with the top of the breast-bone, and its outer extremity with a part of the shoulder-blade called the acromion process.

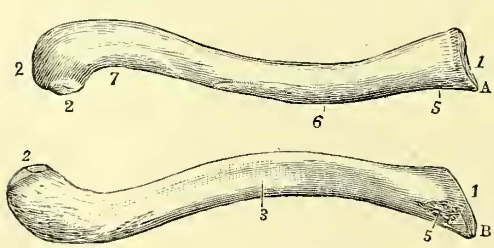


FIGURE 23.—The clavicle, or collar-bone of the right side: A, the front; B, the lower side of the same bone; 1, end attached to the breast-bone; 2, end attached to the shoulder-blade.

The *scapula* or *shoulder-blade* is situated at the back of the shoulder. Its shape is roughly triangular. It is quite thin, but at the upper and outer angle it is thickened and presents a smooth, shallow, cup-like surface for articulation with the arm-bone. This socket is protected by two bony prominences ; that in front, about

an inch and a half in length and of a hooked form, is called the *coracoid* process; that behind is the thickened extremity of a strong bony ridge or *spine* that crosses the back of the shoulder-blades and is called the *acromion* process.

The *arm-bone*, or *Humerus*, is a long bone, with a shaft generally cylindrical, a rounded upper extremity or head, and a large lower extremity made up of two prominences called the inner and outer condyles, between which is an irregular, pulley-like surface for articulation with the ulna, one of the bones of the forearm. About an inch and a half below the head of the bone is a narrowing of

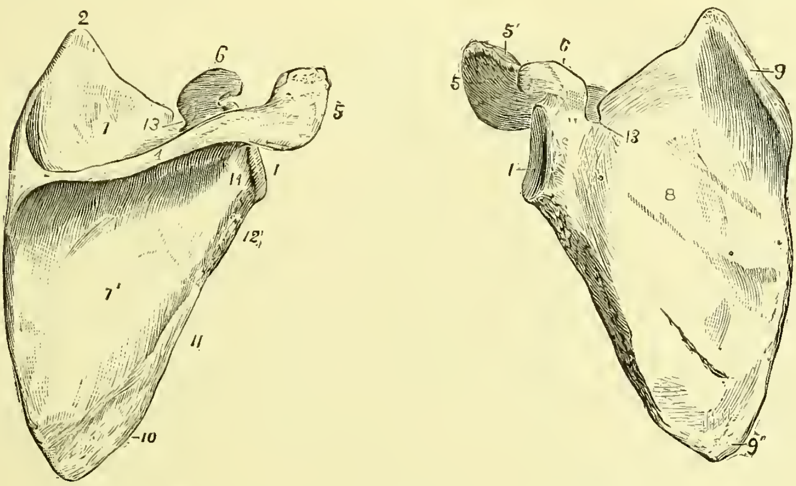


FIG. 24. FIG. 25.

FIGURES 24 and 25.—Right scapula or shoulder-blade: 1, socket for the head of the arm-bone, or humerus; 2, upper angle; 3, body of the bone; 4, spine or ridge which terminates in 5, the acromion process, which makes the upper and hinder boundary of the shoulder-joint; 6, coracoid process, to which the outer end of the clavicle is attached; 7, surface above the spine; 8, smooth under-surface fitting to the muscles covering the ribs.

the shaft, called the surgical neck, owing to its being the frequent seat of fractures of this bone. The lower extremity of bone is likewise often broken.

The forearm has two bones called the *Ulna* and the *Radius*. The former forms the point of the elbow, and when the hand is held with its palm upward, occupies the inner side of the forearm. It is somewhat longer than the radius, and is larger at the elbow than at the wrist. From the upper end of the bone arise two prominences: that at the extreme end and back of the bone (popularly called the "funny bone" or "crazy bone") is called the *olecranon*. The other, a little farther down and on the front of the bone, is called the *coronoid* process. To the olecranon is at-

tached the triceps, the strong muscle that straightens the arm; to the coronoid, the brachialis anticus, one of the muscles that bend the arm. Between the two processes is a semi-lunar depression called the sigmoid cavity, by means of which this bone unites with the humerus to form the elbow-joint, which is possessed of a hinge-joint motion. The lower end of the ulna is quite small and

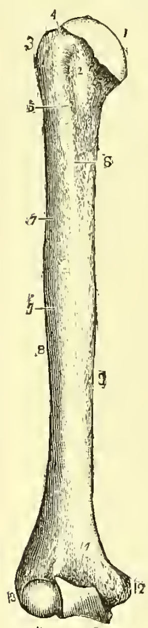


FIG. 26.

FIG. 27.

FIG. 28.

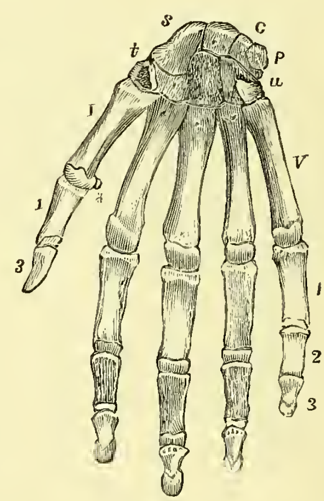


FIG. 29.

FIGURE 26.—Humerus or arm-bone: 1, surface which articulates with the shoulder-blade; 2, the lesser, and 3, the greater tuberosities—points to which important muscles are attached; 4, neck; 5, groove in which the long tendon of the biceps lies; 6, attachment of the latissimus dorsi and teres major muscles; 7 to 7′, limit of insertion of the tendon of the pectoralis major muscle; at 7′ is also attached the deltoid; 10, surface for articulation with the ulna; 11, rounded surface for articulation with the upper end of the radius; 12, 13, inner and outer condyles; 14, fossa or pit into which the coronoid process of the ulna fits when the arm is forcibly bent.

FIGURE 27.—Radius: 1, head of the bone; 2, point of bone for attachment of tendon of the biceps muscle; 7, styloid process; 8, the hollow into which the lower end of the ulna fits; between 7 and 8 are the grooves for the tendons of the extensor muscles.

FIGURE 28.—The ulna: 2, the olecranon process; 3, coronoid process; 5, lesser sigmoid cavity, in which the head of the radius turns; 7, lower extremity or head; 8, the styloid process.

FIGURE 29.—Bones of the wrist and hand: the letters indicate the several bones of the carpus; I to V, the bones of the metacarpus; the phalanges are numbered from 1 to 3.

rounded, and forms the prominence seen at the outside of the wrist when the back of the hand is held upward.

The radius is larger below and forms the bulk of the wrist-joint on the part of the forearm. This large lower extremity is slightly hollowed out, and the shallow cup thus formed allows the hand to move by a gliding motion, not only to and fro as a hinge, but

somewhat from side to side. The upper end of the radius is smaller, rounder, with a prominent ridge about it like the head of a nail. This head articulates with the humerus and with the ulna. Below the head is a constriction, called the neck, which is encircled by a ligament, the bone turning around in the ligament. By means of this arrangement, and the ligaments between the two bones at the wrist, the peculiar power of turning the hand over is accomplished. Thus, when the hand is held palm upward, the two bones of the forearm are nearly parallel. When the palm is down, the ulna has not changed its position, but the radius has revolved so as to cross the top of the ulna.

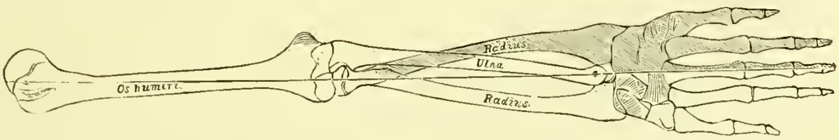


FIGURE 30.—The position of the bones of the forearm when the hand is in the prone (palm downward) position, and in the supine (palm upward) position; the head of the ulna serving as the centre of rotation.

The *Carpus* or *Wrist* is composed of eight small bones arranged roughly in two rows. The row next the forearm, counting from the thumb side, contains the scaphoid, the semilunar, the cuneiform, and the pisiform bones. The row next the hand, counting in the same way, contains the trapezium, the trapezoid, the os magnum, and the unciform bones.

The body of the hand is made up of the metacarpal bones, one for the thumb, and one for each finger. The upper ends of them may be recognized by a row of prominences on the back of the hand, about opposite the thickest part of the palm of the hand; the lower ends form the knuckles. The thumb has two bones, called the phalanges, one for each joint; the fingers have each three bones arranged and named in the same manner.

The Lower Extremity.

The *Lower Extremity* consists of three parts, the thigh, the leg, and the foot. It is connected to the trunk by the haunch-bone, which bears the same relation to the lower extremity that the shoulder does to the upper extremity.

The haunch-bone, or *os innominatum*, is a very large, irregular, flat bone, composed of three bones, which unite to form one about the age of puberty. These component bones are called the ilium, the ischium, and the pubis. The ilium is chiefly thin, with stout margins, and comprises the upper and larger part of the whole

bone. Its upper margin or crest forms what is popularly called the hip-bone. It unites behind with the sacrum, already described. The lower extremity of the haunch-bone is called the ischium, or seat-bone. Upon the stout tuberosities of the ischium we sit. The remaining part of the haunch-bone is the pubis, which is in shape rather like the letter V. The point of the V meets its fellow of the opposite haunch-bone, one arm of the letter runs upward and backward to meet the ilium, and the other downward and backward to join the ischium. Between the arms of the V is a large opening through the bone. At the junction of these three parts of the haunch-bone, or in the middle of the united bone, is a deep, cup-shaped depression, called the acetabulum, which is the socket into which the head of the thigh-bone fits.

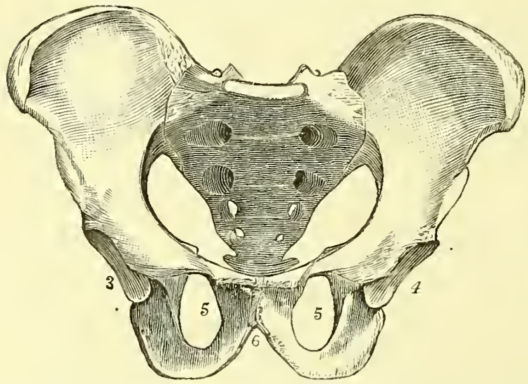


FIGURE 31.—The male pelvis, composed of the two *ossa innominata* or haunch-bones—4, 4, having between them in the rear the sacrum, and joined at the front by the pubic symphysis (6); the figures 3, 4 are placed opposite the acetabula, or surfaces against which the heads of the thigh-bones rest. The two broad surfaces are the wings of the iliac bones, better shown in the next figure (6, 6).

The two haunch-bones, joined in front by the articulation of their pubic portions, together with the sacrum behind, form the strong ring of bone which serves to support the trunk upon the lower extremities, and the cavity of this ring forms a kind of basin, deeper behind than before, which contains important organs, and is of great interest as regards the mechanism of childbirth. The united bones are called the *pelvis*.

The thigh has but a single bone, the *femur*, which is the largest, longest, and strongest bone in the skeleton. Its shaft is cylindrical, with a rough ridge at its back. At the upper end of the shaft are two prominences : one on the inner side, called the lesser trochanter ; the other on the outer side, called the great trochanter. The latter forms the bone felt just beneath the skin opposite the hip-joint. The neck proceeds from the shaft at an obtuse angle, and is surmounted by a rounded head which fits into the cup-shaped socket in the haunch-bone. The lower end of the thigh-bone is larger than the shaft, being rather club-shaped, with an enlargement on either side called a condyle; the inner condyle is the more prominent, and extends farther downward than the outer, but,

owing to the oblique position the thigh-bone occupies when the figure is standing erect, the two condyles are then nearly on the same level. Between the two condyles is a deep notch. From the shape of the head of the femur and of the socket in the haunch, it will be seen that the hip-joint is a ball and socket joint, while the shape of the condyles fits them for entering into a hinge-joint only. Such a joint it makes with the principal bone of the leg, the tibia or shin-bone.

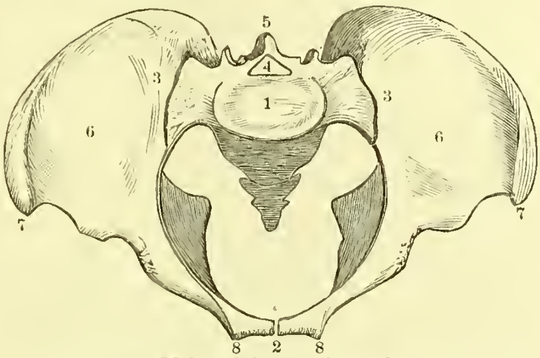


FIGURE 32.—Male pelvis seen from above: 1, sacrum; 2, symphysis pubis; 3, 3, points of union between the sacrum and the ilium of either side; 4, the spinal foramen; 5, spinous process; 6, 6, the broad wings of the ilia forming a greater part of the floor of the abdominal cavity; 7, 7, anterior superior spinous processes, from which firm ligamentous cords pass to the spinous processes of the pubic bone (8, 8,) and form points for attachment of some of the muscles of the abdominal wall, and protection for the large vessels which pass out from the abdomen to the thighs.

In front of the knee-joint is placed an irregularly disc-shaped bone, the *knee-pan* or *patella*. This is developed in the tendon of the strong muscle, the quadriceps extensor of the leg. It serves to increase the leverage of the muscle, and to protect the front of the joint, which is, from its position, naturally much exposed to injury.

The leg has two bones, the *tibia* or *shin-bone*, and the *fibula* or *splint-bone*. They are of about the same length, but the tibia is much the larger of the two. The upper extremity or head of the tibia is quite large, having on the inner and outer side an enlargement called a tuberosity, and corresponds with the condyles of the femur in making up the hinge of the knee-joint. These tuberosities can be easily felt at either side of the leg, just below the knee-joint; and in front between them will be noticed a small projection, which is called the tubercle of the shin-bone, and to which is attached the tendon of the great extender of the leg already mentioned. The shaft of the shin-bone is an irregularly triangular prism, with a very sharp edge in front. At its lower extremity the bone again becomes enlarged, and at the end has a surface for articulation with the foot. From the inner side of this lower extremity a projection of bone extends downward, which is called the malleolus; this is what is popularly known as the inner ankle-bone.

On the outer side of the tibia is placed the *fibula*. This is a very slender bone. Its upper end is placed against the outer tu-

berosity of the shin-bone, and its lower extremity lies against the outer side of the lower extremity of the tibia, but projects beyond it in such a manner as to form the outer ankle-bone.

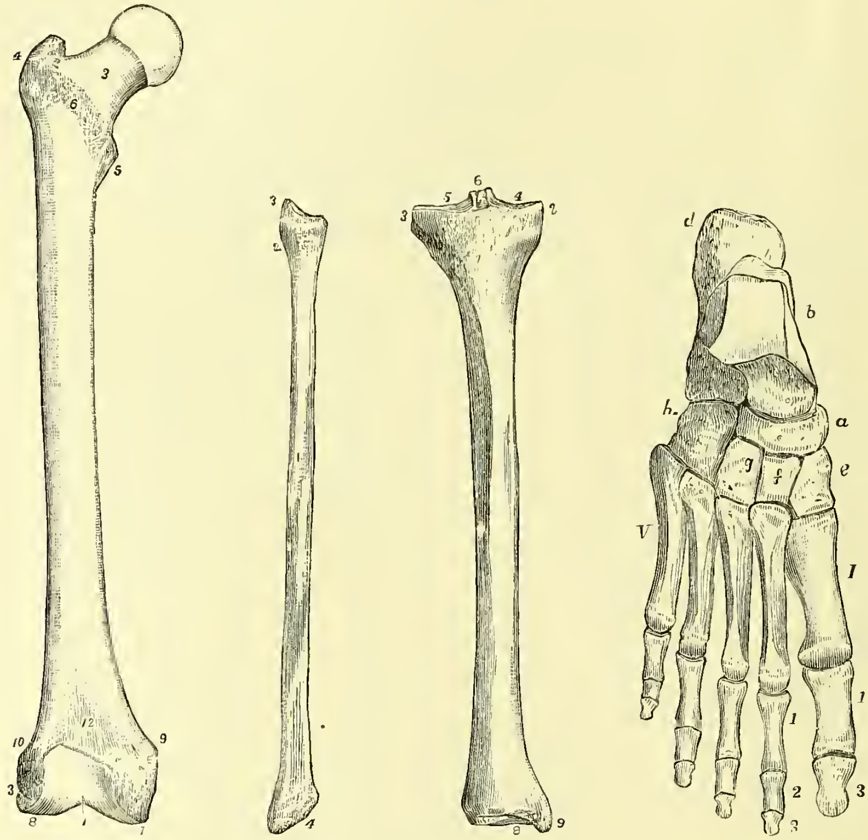


FIGURE 33.—Bones of the lower extremity: A.—The Femur: 1, lower end articulating with the head of the tibia (C); 3, the neck; 4, greater trochanter; 5, lesser trochanter; 6, intertrochanteric line, into which a number of tendons are inserted; 7, inner condyle; 8, outer condyle.

B.—The Fibula: its upper extremety (3) articulates with the head of the tibia at 3.

C.—The Tibia: 2, 3, the inner and outer tuberosities; 4, 5, the inner and outer articular surfaces on which the corresponding portion of the femur (7 and 8) rests; 7, the prominence at which the tendon of the large muscle on the front of the thigh is attached.

D.—Bones of the right foot seen from above. The italic letters refer to the tarsal bones: *a*, scaphoid; *b*, astragalus; *d*, os calcis; *e*, internal or first cuneiform; *f*, middle cuneiform; *g*, external cuneiform; *h*, cuboid; I to V, the metatarsal bones; 1, 2, 3, first, second, and third phalanges of the first and second toes.

The foot, like the hand, is made up of three divisions: they are the Tarsus, the Metatarsus, and the Phalanges.

The *Tarsus* is made up of seven bones, namely, the calcaneum

or os calcis, astragalus, cuboid, scaphoid, and the internal, middle, and external cuneiform or wedge-shaped bones. The largest and strongest of these is the os calcis or heel-bone. It forms the heel, and is the posterior support of the foot considered as an arch bearing the weight of the body, and, by reason of its projection backward beyond the ankle-joint, it forms a strong lever for the attachment of the muscles of the calf which raise the heel in walking and the like. The *cuboid* bone lies in front of the os calcis, on the

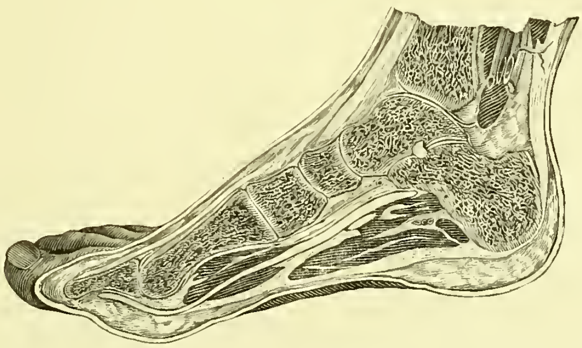


FIGURE 34.—Section through the right foot, showing the arrangement of the bones and soft tissues.

outer side of the foot. The astragalus lies on the forward part of the os calcis, and is the bone that works in a hinge-like manner against the shin-bone and between the inner and outer ankle-bones, forming with them the ankle-joint. Its upper surface is smooth and pulley-like for forming this articulation. The scaphoid bone lies in front of the astragalus, on the inner side of the foot. In front of it are three wedge-shaped bones, the external one adjoining the cuboid bone.

Running forward from the wedge-shaped bones and the cuboid are five *metatarsal* bones, one corresponding to each toe. The first bone, corresponding to the great toe, is much stouter than the others, although it is the shortest of all. Its farther extremity or head composes the largest part of the prominence of the great toe-joint, and the bone can be easily recognized beneath the skin on the inner margin of the foot between that joint and the instep. The last metatarsal bone has a peculiar enlargement at its base, which makes a decided prominence upon the outer margin of the foot. The *phalanges* are arranged like those of the hand, viz., two for the great toe and three for each of the others.

THE JOINTS.

Every bone is connected with one or more others, and the connection is called a *Joint* or an *Articulation.* The kinds of joints are very numerous, as under that name are included simple dovetailing of bones, as in the skull; mortise and tenon joints, as the teeth in the jaw; and so on to the perfectly movable joints, as the hinges of the knee and elbow, or the ball and socket of the shoulder and hip. Joints are divided into immovable, movable, and mixed. In the immovable joints the bones are almost in immediate contact, and are kept there without the assistance of other organs. But in a true movable joint several things are always found, although their arrangement varies with the particular joint. These movable joints "are formed by the approximation of two contiguous bony surfaces, covered with cartilage, connected with ligaments, and lined by a synovial membrane."

The cartilage that covers the articulating surfaces of bones is called *permanent cartilage,* to distinguish it from the temporary cartilage of which we have spoken as forming the bones in their original state. The permanent cartilage shows no tendency in health to become bony. Besides being present in the joints, this permanent cartilage is found attached to the ribs, in the ear, nose, eyelids, windpipe, etc. Cartilage is of a pearly color, sometimes yellowish. It is firm, opaque, and quite elastic. That in the joints is called articular cartilage. It is smooth and shining on its free surface, and on its attached side takes the form of the rough surface of the underlying bone. In adult life it has no blood-vessels, nor are nerves known to exist in it.

The *synovial membrane* is a thin, delicate membrane of a tube-like shape, attached by its open ends to the margins of the ends of the bone. This is the simple idea; but by reason of its covering the inner side of the ligaments and wrapping around any ligaments or tendons passing through the joint, the shape of the synovial membrane in some joints becomes very complicated. The liquid secreted by these synovial membranes resembles the white of an egg. It is secreted most freely on motion, and very slightly if the joints are kept perfectly at rest.

The *mixed* joints are much simpler in their construction than the movable joints. The bones are connected by a fibro-cartilage, or by two fibro-cartilages with a partial synovial membrane between them. The joints of the backbone are of the former kind, and the joints of the pelvis of the latter.

The *Ligaments* are strong bands of fibrous tissue connecting the bones together and covering in the joints.

The only articulations in the spinal column deserving special mention are those of the first vertebra of the neck, above with the skull, below with the second vertebra. The skull rests, as we have seen, by two smooth prominences of the occipital bone upon two shallow cups, one on each side of the first vertebra. On these the head, held in place by strong ligaments, rocks forward and backward. Between these two shallow cups the odontoid process of the second vertebra projects through the ring of the first. The process is grasped by a ligament called the transverse, so that the first vertebra, carrying the head with it, revolves around the odontoid process as a pivot, and thus permits the turning of the face to one side or the other.

The ribs in front present the peculiarity of not being directly

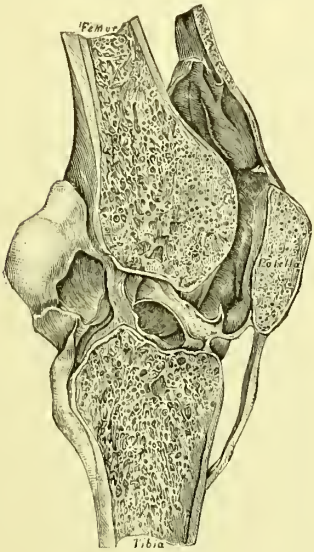


Fig. 35.

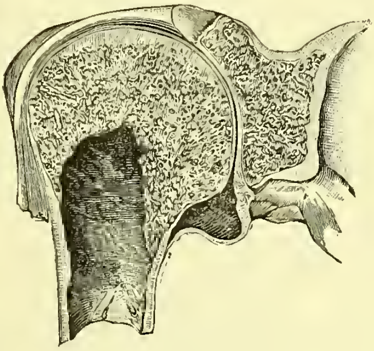


Fig. 36.

Figure 35.—Section through a knee-joint, in which the sinovial membrane has first been distended with air and dried so as to separate the bones and show the extent to which they are covered with the membrane.
Figure 36.—Section through the shoulder-joint.

articulated to the breastbone, but they are joined to the costal cartilages, which are short above and quite long below, and the cartilages, in their stead, enter into the formation of perfect movable joints with the breastbone.

The joints of the extremities are all movable joints, and show the various forms of gliding joint, hinge-joint, ball and socket joint, or pivot-joint. The largest and most complicated of them all is the knee-joint, which is one of the hinge-joints. In addition

to strong ligaments before, behind, and on either side of the joint, it has within the joint two semilunar fibro-cartilages not directly attached to the bone, which deepen the cup-shaped cavity of the shin-bone, into which the rounded ends of the thigh-bone fit. Still farther, there are within the joint four ligaments and folds of synovial membrane strong enough to have received the name of ligaments. The synovial membrane is very large, not only lining the joint, but covering the semilunar cartilages and the ligaments within the joint, doubling on itself, forming in several places thick folds, and extending up behind and above the knee-pan.

The office of the joints is simple, namely to permit of motion of one bone upon another, without which locomotion or any action of the body would be impossible. To put this jointed frame into motion, other organs are demanded, and these are

THE MUSCLES.

There are in the body two kinds of muscles, the voluntary muscles, or muscles of animal life (called, also, the striped muscles) and the involuntary muscles, or muscles of organic life, or unstriped muscles. The *voluntary* muscles make up a large portion

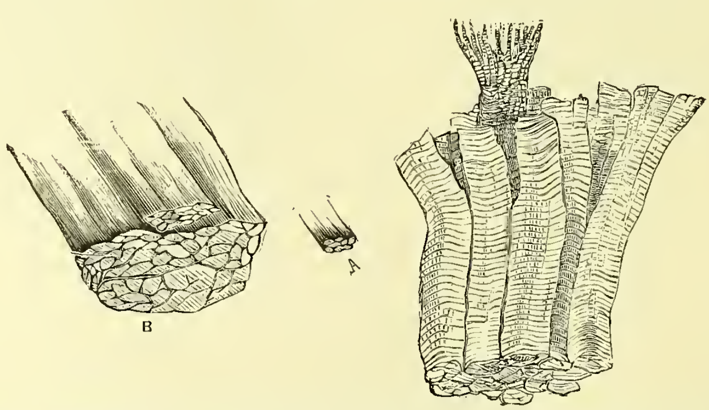


FIGURE 37.—Muscular fibres of the striped or voluntary variety: A, small portion of muscle, natural size; B, the same magnified 5 diameters. The figure to the right is a few muscular fibres, being part of a small fasciculus, highly magnified, showing the transverse striations or cross-markings.

of the body (about two-fifths of its entire weight), covering the bony frame in nearly every part. The name voluntary is given them, because they can be set in motion or controlled by the will. The structure of such a muscle is as follows. It is composed of bundles of fibres inclosed in webs of connective tissue; these bundles are made up of smaller ones, and these again of yet smaller ones, known by the name "primitive fasciculi." These last are on an

average about $\frac{1}{400}$ of an inch in diameter, are marked by peculiar cross stripes (see cut), and are made up of "primitive fibrils," which are very fine cross-marked threads, resembling somewhat in appearance a string of beads, and are about $\frac{1}{25000}$ of an inch in diameter. All the striped muscles act strongly, quickly, and under the influence of the will, with the exception that the heart, the muscles of the pharynx and gullet, used in swallowing, and some other less important ones are not under the control of the will. The heart beats as well when we are asleep as when we are awake, and anything that passes into the pharynx is swallowed involuntarily. The voluntary muscles are set in motion by means of an arrangement of the nerves, which we shall describe later.

The *involuntary* muscles consist of flattened spindle-shaped fibres, ordinarily $\frac{1}{500}$ of an inch long and $\frac{1}{4000}$ broad (see Figure). They are found forming one of the coats of the entire digestive tube, and of most of the hollow organs of the body as well as of the blood-vessels. They differ in their action from the voluntary muscles in that they do not contract immediately upon the application of a stimulus, but slowly, the contraction enduring for a while and then gradually relaxing.

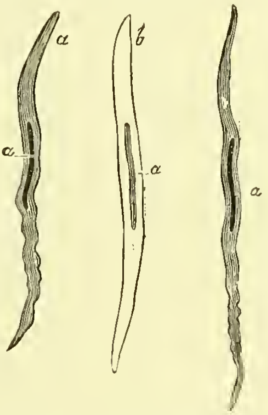


FIGURE 38. — Unstriped, spindle-shaped, or involuntary muscular fibres from human arteries; magnified 350 diameters: *a*, natural state; *b*, treated with acetic acid, so as to make the nucleus more apparent.

It is easy to see the advantage of the peculiar action of the two kinds of muscle. The motions of the body need to be done promptly and strongly under the influence of the will; while it is equally essential that the motions of organic life upon which the proper nutrition of the body depends, should go on certainly and surely without regard to our volition.

The voluntary muscles vary very much in shape and in size. In some the fibres run more or less parallel, in others they are arranged like the fringes of a feather, in others they are fan-shaped. The places of attachment of a muscle to bone or to any other structure are called its *origin* and *insertion*. That point which is relatively the more fixed is called the origin, and the other the insertion. For instance, the large muscle in front of the arm-bone is attached above to two points on the shoulder-blade, and below to the radius, one of the bones of the forearm; since the shoulder-blade is usually much more fixed than the forearm, the upper attachments are called the origin. The attachment of the muscles to bones, etc., are by means of strong fibrous tissue variously ar-

ranged to suit the requirements of the special muscle. The commonest arrangement of the fibrous tissue is into strong cords called *tendons* or *sinews*. When the fibrous structure is spread out in sheet-like manner it is called an *aponeurosis*. *Fascia* is the name given to a membrane containing more or less fibrous tissue. These are found throughout the body, holding muscles and organs in their proper positions. The fascia that lies just beneath the skin is not very strong in its structure, and generally holds in its meshes considerable fat, while the deeper fasciæ are really aponeurotic in character.

The whole number of muscles in the body is very great, amounting to some hundreds. In passing, only a few will be mentioned, such as have some especial interest to the general reader.

Muscles of the Head and Face.

The muscles of the head and face need not detain us long. Although there are upwards of thirty of them, they are chiefly small,

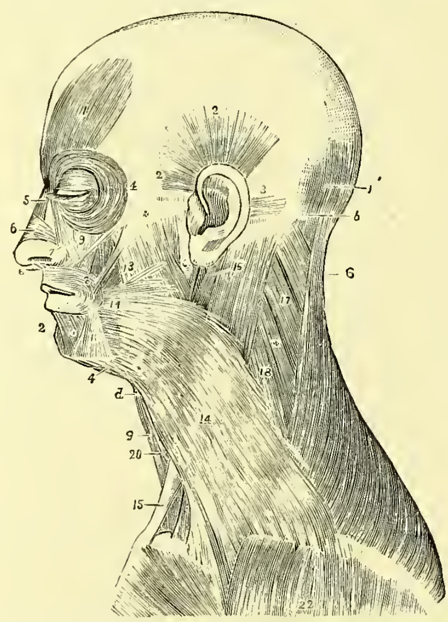


FIGURE 39.—Muscles of the head and neck: 1, 1′, the two portions of the occipito-frontalis muscle; 2, 2, 3, three muscles (more largely developed in animals) which move the ear; 4, orbicularis palpebrarum, the muscle which closes the eyelids; 5–7, muscles of the nose; 8, orbicularis oris, the muscle which puckers the lips; 13, masseter muscle; 14, platysma myoides, a broad, thin muscle which gives motion to the skin overlaying it; 15, sterno-cleido-mastoid muscle; 16, trapezius; 17, 18, muscles which raise the shoulder-blade, or, when it is fixed, draw the head to either side.

and are concerned in the movements of the eyes, nose, and mouth, and become, therefore, muscles of expression. The muscles of the

eye, which have some interest with reference to diseases of that organ, will be described in that connection. The muscles of mastication are the masseter, the temporal and the two pterygoid, and are very powerful. The masseter is quite superficial, running from the prominence of the cheek to near the angle of the jaw. The temporal muscle covers a large part of the side of the head, and its lower extremity is attached to the anterior fork of the vertical part of the lower jaw, already spoken of. The muscles named, four on either side of the face, close the mouth as in biting, move the lower jaw forward upon the upper and in every direction necessary to the process of grinding the food.

In the neck only one muscle need be mentioned. It is that which extends from the top of the breast-bone and the inner end of the collar-bone to the bony prominence just behind the ear. This muscle is called the Sterno-cleido-mastoid. Its action is to bow the head and to turn the face to the opposite side. If the two muscles act together, they bow the head. The muscle is easily recognized in thin persons by its forming a cord-like prominence across the neck. It is of interest as the cause of the deformity known as *wry-neck*. If the muscle be spasmodically contracted, or its fellow be paralyzed, the head will be twisted from the side of the contracted or towards the paralyzed side.

Muscles of the Trunk.

The muscles of the trunk are very numerous, but those that need to be here mentioned are very few. On the back alone, upwards of thirty muscles have received names, but we need describe only the two large ones that make up the first or most superficial layer. These are the trapezius and the latissimus dorsi. The *trapezius* has a very extensive origin, by means of an aponeurosis, from the occipital bone of the skull, from the *ligamentum nuchœ* (a stout ligament extending from the occiput to the spinous process of the seventh vertebra of the neck), from the spinous processes of the seventh cervical, and the entire twelve dorsal vertebræ. (See Fig. 40.) The muscle is inserted into the spine of the scapula. It gets the name trapezius, from the fact that, with its fellow of the opposite side, it forms a trapezium, or more properly a trapezoid. It has also been called the cucullaris or cowl muscle. The action of the muscle is to raise the point of the shoulder, if the head is fixed ; to bend the head towards the shoulder, if the latter is fixed, or, if both act, to throw the head backward.

The *latissimus dorsi* covers the back below the trapezius. Its

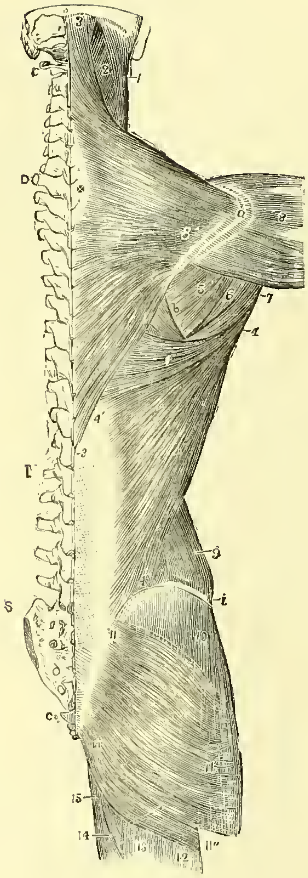


FIG. 40.

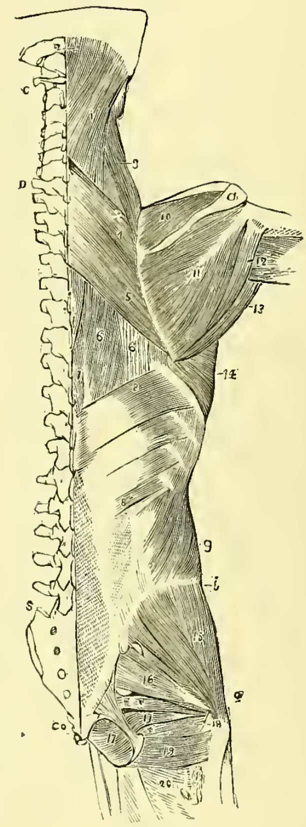


FIG. 41.

FIGURE 40.—The outer layer of muscles of the back, shoulder, and hip: C, transverse process of the atlas; D, first dorsal vertebra; L, first lumbar vertebra; S, sacrum; Co, coccyx; *a*, acromion; *b*, base of scapula; *i*, crest of ilium; 1, upper part of sterno-mastoid muscle; 2, muscle which raises the scapula; 3, 3, upper and lower ends of trapezius muscle; *, half of the oval tendon belonging to the base of the trapezius muscle; 4, 4, latissimus dorsi muscle; 5, infraspinatus; 6, teres minor; 7, teres major; 8, middle or acromial part of the deltoid; 9, hind part of the external oblique muscle of the abdomen; 10, gluteus medius; 11, 11′, gluteus maximus; 12, biceps; 13, semitendinosus; 14, adductor magnus; 15, gracilis.

FIGURE 41.—The same as the foregoing, after the removal of the trapezius, latissimus dorsi, deltoid, gluteus maximus, and external oblique muscles. The muscles are: 1, splenius capitis; 3, raiser of the angle of the scapula; 4 and 5, the lesser and greater rhomboid muscles—these move the shoulder-blade or help to fix it when the arm is being used; 6, part of the long muscle of the back; 8, 8′, the lower serrated muscle, the action of which is to pull the ribs downward; 9, the internal oblique muscle of the abdomen; 10, supraspinatus; 11, infraspinatus (partly seen in the foregoing; the white space between is the spine of the shoulder-blade terminating in the acromion (*a*); 12, 13, small and large teres muscles; 14, large serratus; 15, middle gluteus (see 10 in the foregoing); 16 to 19, muscles which are inserted into the great trochanter of the femur; 20, part of the great adductor muscle.

origin, likewise, by aponeurosis, is from the spinous processes of the lower six dorsal vertebræ, and from those of all the lumbar and sacral vertebræ. The upper part of the origin lies beneath the trapezius. From this extensive origin the fibres converge ; are twisted upon themselves into a sort of cord, and are finally inserted into the front of the arm-bone just below its head. The border of the muscle forms the posterior margin of the armpit. The latissimus draws the arm downward, backward, and rolls it inward. The act of putting the hand into a pocket in the opposite skirt of the coat, very nearly expresses the action of the muscle.

Muscles of the Abdomen.

The wall of the abdomen is made up chiefly of muscles. The central part of the wall contains the two *recti* (or straight) muscles ; one of these lies on either side of the central line of the belly. They arise from the pubic bones below, and running directly upward, are inserted into the cartilages of the fifth, sixth, and seventh ribs. The remainder of the front and the sides of the abdominal wall are made up by three muscles, which lie like layers, called the external oblique, the internal oblique, and the transversalis.

The *external oblique* arises from the lower eight ribs. Some of its fibres—those farthest back—run downward to the forward half of the margin of the haunch-bone ; the others run downward and forward to a broad aponeurosis, which covers in the rectus muscle, already described, and, together with its fellow, covers the whole front of the abdomen. That part of the aponeurosis that extends from the anterior superior spinous process of the haunch-bone to the pubis (see Fig. 42), makes a strong band called Poupart's ligament, and should be remembered as a landmark frequently to be used in descriptions farther on. Just above Poupart's ligament the aponeurosis is split, forming what is called the external abdominal ring. Through this passes the spermatic cord leading to the testicle, and through it, also, parts of the intestine are forced in certain forms of hernia or rupture.

The *internal oblique* muscle lies behind the external oblique. Its fibres arise from the haunch-bone and from Poupart's ligament, and run upward and forward (and the lower ones a little downward) in a somewhat fan-shaped arrangement, to be inserted into the cartilages of the four lower ribs, and into an aponeurosis, like that of the external oblique, and into the pubis.

The *transversalis* muscle lies yet deeper. As its name implies, the course of its fibres is more nearly horizontal than those of the

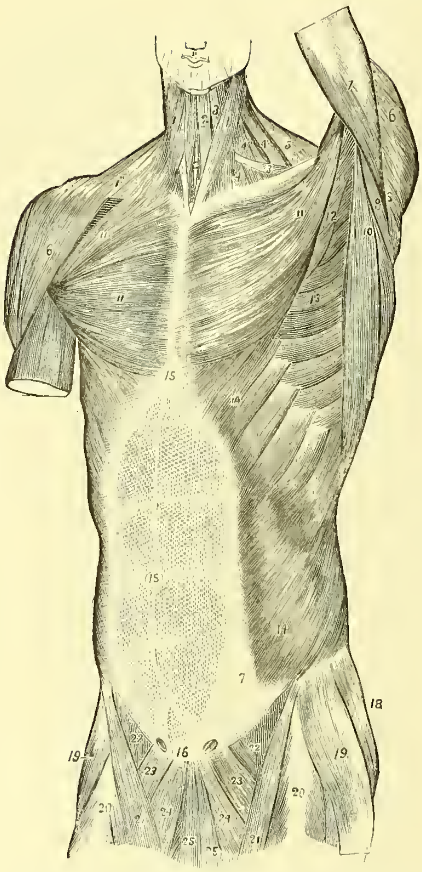


FIG. 42.

FIG. 43.

FIGURE 42.—1, 1, on the right side—the number rests over the platysma myoid muscle, on the left over the sterno-mastoid; 2, sterno-hyoid; 3, 3, upper and lower bellies of the omo-hyoid; 4, raiser of the angle of the scapula; 5, front border of the trapezius; 6, deltoid; 7, upper part of the triceps; 8, 9, the teres muscles; 10, latissimus dorsi; 11, pectoralis major; 12, part of the pectoralis minor; 13, great serrated muscle; 14, external oblique muscle of the abdomen; 15, 15, the upper one is placed over the xyphoid cartilage at the end of the breast-bone, the lower one at the navel; 16, on the symphysis pubis, is placed between the outer openings of the inguinal canals; 17, the tendinous aponeurosis of the external oblique muscle; 18, part of the middle gluteus; 19, the muscle which renders tense the tendinous envelope which ensheathes the muscles of the thigh and renders them compact when in action; 20, rectus; 21, sartorius; 22, part of the iliac and psoas muscles; 23 to 25, muscles which aid in drawing the thigh inward and forward.

FIGURE 43.—Deep layer of muscles of the chest and abdomen: *a*, coracoid process of the shoulder-blade; *b*, breastbone; *c*, cartilages of the fifth rib; 1, upper part of the raiser of the angle of the scapula, showing its origin from the transverse processes of the vertebræ in the neck; 2, collar-bone; 3, small pectoral muscle; 4, subscapular muscle (having its origin from the under side of the shoulder-blade); 5, upper end of the coraco-brachial muscle; 6, 6′, the short and long head of the biceps muscle (the groove in which the latter lies in the front of the arm-bone was indicated in the figure of the bone); 7, tendon of the latissimus dorsi; 8, tendon of the great pectoral muscle (11 in foregoing figure), cut short and folded outward; 9, tendon of the deltoid, cut short; 10, upper part of the anterior brachial; 11, part of the triceps; 12, 12, on the fifth and eighth ribs, near the insertions of the tendons of the great serrated muscle of the back; 13, 13, 13, the rectus muscles of the abdomen (on the left side the central portion of the muscle has been removed); 14, pyramidal muscle; 15′, Poupart's ligament and the internal oblique muscle; the opening between it and 15″ is the inner opening of the inguinal canal; 16, tendon of the external oblique muscle of the abdomen.

Between the ribs are shown the external intercostal muscles.

oblique muscles. It arises from Poupart's ligament, from the crest of the haunch-bone, from the cartilages of the lower six ribs, and from the lumbar aponeurosis, which closes up the interval in the back between the ribs and the haunch-bone. The lower fibres curve downward, and with those of the internal oblique form what is called the conjoined tendon, of interest with reference to hernia. These fibres go to the pubis, the remainder to an aponeurosis, the upper three-fourths of which passes behind the rectus muscle, the lower fourth of it in front. The actions of the muscles of the abdomen are: if the chest and pelvis are fixed, to expel the contents of the stomach in vomiting, of the bowel in defecation, of the bladder in urinating, or they assist in expelling the child in labor. If the spine is fixed they may be made to assist in expiration, when there is any obstruction to free passage of the air. They also bow the trunk forward, and in climbing they draw up the pelvis.

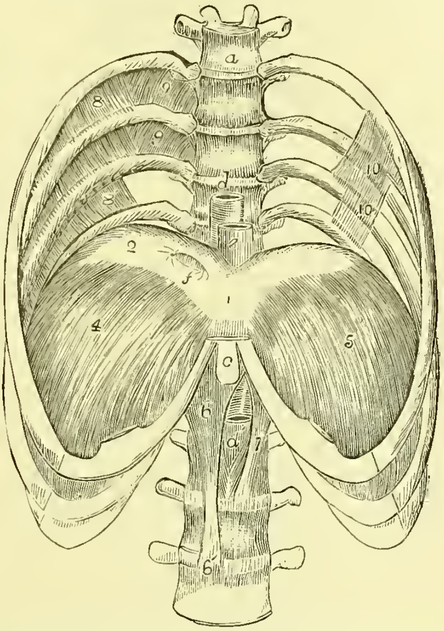


FIGURE 44.—Lower part of the chest, showing the diaphragm: *a*, sixth dorsal vertebra; *c*, ensiform cartilage of the breastbone; *d*, the aorta, cut across, lying in front of the spinal column; *d'*, the aorta appearing below the arch formed by the pillars of the diaphragm; *e*, esophagus or gullet (cut across) descending through the tendon in the centre of the diaphragm; *f*, opening for the passage of the inferior vena cava; 1, central tendon of the diaphragm; 4, 5, right and left muscular portions of the diaphragm; 6, 7, the pillars of the muscle arising behind from the lumbar vertebræ; 8, 8, 10, 10, internal intercostal muscles; 9, 9, external intercostal muscles.

On the walls of the chest are a number of small muscles chiefly employed in the movements of the ribs during respiration. [See Figure 43.] The most important of these are the intercostal muscles, so called from their position between the ribs. They are divided into two groups, the external and the internal. Each group is composed of eleven muscles on each side. The fibres of the *external* intercostals run downward and forward from the lower margin of one rib, to the upper margin of the rib below. The *internal* intercostals are situated within the external intercostals, and their fibres run downward and backward from one rib to the next. The external intercostals when contracting raise the ribs, and thus are muscles of inspiration. That portion of the internal intercostals which is situated between the cartilages of the ribs assists the ex-

ternal muscles, while the portion between the ribs themselves act as depressors of the ribs, and hence expel the air from the chest.

The *diaphragm* is the very strong partition composed of muscular and fibrous tissue which divides the cavity of the chest from that of the abdomen. It is attached to the entire circumference of the chest-wall, to the cartilaginous tip of the breast-bone in front, and on each side to the cartilages and bony parts of the lower six or seven ribs, to two aponeurotic arches, and to the lumbar vertebræ. The whole muscle has a shape much like that of a palm-leaf fan. The fibrous part is mainly arranged in a horseshoe in the middle of the fan, and the muscular fibres run in all directions from it to the walls of the chest. Openings near the middle allow the passage of the gullet, of the great artery of the body—the aorta, and of the great vein—the ascending vena cava. The muscle has an arch upward like a flattened dome ; is lower behind than before ; lower on the left than the right side, and broken into two arches by a central portion. The central portions support the heart, the side arches, the bases of the lungs. When the muscle contracts, the arch of the diaphragm becomes still flatter, and by so doing increases the cavity of the chest. The bottoms of the lungs sink about two inches, air rushing in through the trachea to fill them. The diaphragm thus becomes the most powerful muscle of inspiration. In expiration it is passive, the abdominal organs displaced by the act of inspiration simply pushing back the muscle. The muscle also acts in all expulsive efforts : such as vomiting, straining at stool, etc.

Muscles of the Upper Extremities.

The *muscles of the upper extremities* are generally made to include those of the front and side of the chest, as well as those of the shoulder, arm, forearm, and hand.

The rotundity of the breast is chiefly made up of the *greater pectoral muscle.* Its broad origin runs along the inner half of the collar-bone, down the breast-bone, and along the cartilages of all the true ribs and the aponeurosis of the external oblique muscle of the abdomen. The fibres converge towards the upper part of the arm-bone, being somewhat twisted upon each other, and form the front of the armpit, as may be readily made out by feeling this edge while the arm is forcibly drawn to the chest. The muscle is inserted into the front of the arm-bone in its upper third, just below its surgical neck. The effect of this muscle is to draw the arm inward or across the chest, and to draw the shoulder downward if raised. Its action is assisted by the *lesser pectoral,* which lies beneath the greater pectoral muscle.

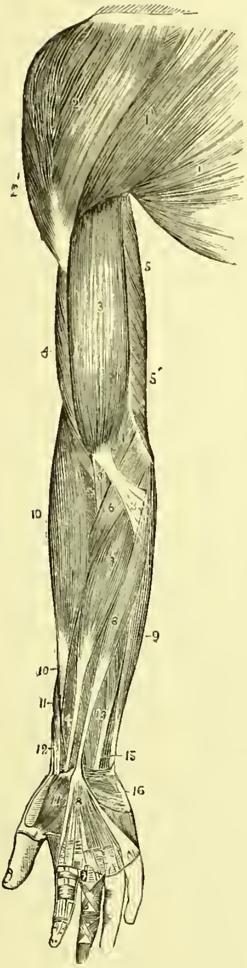


FIG. 45.

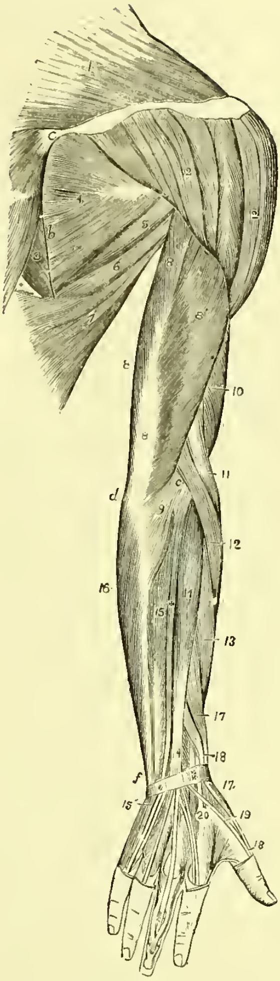


FIG. 46.

FIGURE 45.—The outer layer of muscles of the upper extremity, seen from in front: 1, 1, greater pectoral; 2, deltoid; 3, biceps; 3′, its tendon of insertion into the radius; 3″, the portion inserted into the tendinous sheath which encloses the muscles of the forearm; 4, anterior brachial muscle; 5, 5′, inner border of the triceps; 7, radial flexor of the wrist; 8, long palmar, passing at 8′ into the palmar aponeurosis; 9, ulnar flexor of the wrist; 10, long supinator; 11, extensor of the metacarpal bone of the thumb; 12, extensor primi internodii; 13, lower part of the upper flexor of the fingers; 14, long flexor of the thumb; 15, part of the deep flexor of the fingers; 16, short palmar muscle; 17, abductor of the thumb.

FIGURE 46.—Outer layer of muscles on the back of the upper extremity: *b*, base of the shoulder-blade; *c*, tendon of the trapezius; *d*, olecranon of the ulna; *e*, external condyle of the humerus; *f*, lower end of the ulna; 1, trapezius; 2, 2, deltoid; 3, large rhomboid; 4, infraspinal muscle; 5, 6, the teres muscles; 7, latissimus dorsi; 8, 8, 8, triceps; 10, part of anterior brachial; 11, long supinator; 12, 13, long and short radial extensors of the wrist; 14, common extensor of the fingers; 15, ulnar extensor of the wrist; *, between 14 and 15, extensor of the little finger; 16, part of the radial flexor of the wrist; 17, extensor of the metacarpal bone of the thumb; 18, extensor of the first bone of the thumb; *, and *,*, the ring-like ligament which binds down the tendons of these muscles at the wrist; 19, tendon of the extensor of the second bone of the thumb; 20, the number is placed at the point where the tendon of the radial extensor of the wrist is inserted into the head of the metacarpal bone of the index finger; on the back of the middle finger is shown the insertion of one of the tendons of the common extensor of the fingers (14).

A strong muscle of inspiration is the *serratus magnus*, situated on the side of the chest; it is attached above to the posterior edge of the shoulder-blade, and below to the upper eight ribs. If the shoulder be fixed this muscle raises the ribs; if the ribs be fixed it twists the shoulder-blade so as to raise the point of the shoulder, and is of use in supporting weights on the shoulder.

The round cap of the *shoulder* is made up of the *deltoid* muscle. It arises from the outer part of the collar-bone, the acromion process, and the spine of the shoulder-blade, and is inserted into the outside of the middle of the arm-bone. The muscle raises the arm directly outward from the side until it is level with the shoulder. It is assisted, to a slight degree, by a muscle called the *supraspinatus*, which lies on the shoulder-blade above its spine, and is inserted into the arm-bone near its head. The arm-bone is rolled inward by the *subscapularis* which fills up the inner surface of the shoulder-blade and runs to the humerus near its head. The *greater teres* muscle assists in this motion. The arm is rolled outward by two muscles—the *infraspinatus* and the *lesser teres* muscle, which arise from the lower part of the back of the shoulder-blade and pass to the upper part of the arm-bone.

The front of the *arm* is made up of three muscles, and chiefly by the *biceps* (two-headed) and the *anterior brachial*. The shorter head of the biceps comes from the coracoid process of the shoulder-blade, the longer from the edge of the shoulder-socket. The muscle is inserted into the radius very near its upper extremity. This is the muscle so easily seen on the front of the arm when the elbow is bent, particularly if any considerable weight be held in the hand. The tendon of the muscle and a fascia springing from it are then very prominent in front of the bend of the elbow. Lower down, the front of the arm is made up of the *anterior brachial* muscle which covers the lower half of the arm-bone and which is inserted into the coracoid process of the ulna just in front of the hinge-joint of the elbow. These muscles—the anterior brachial and the biceps, are flexors of the forearm, and are brought into play with the utmost frequency.

The great opponent of these muscles, which straightens the arm, as in striking, is the *triceps* (so called from its three heads—one from the shoulder-blade, two from the arm-bone), which is inserted into the olecranon process of the ulna (the "funny-bone.")

The *forearm* has twenty muscles. If the hand be held palm upward the outside of the forearm will be noticed to be quite full and round at its upper part; this rotundity is chiefly due to the *long supinator*. It arises on the outer side of lower part of the arm-bone and extends to the lower end of the radius. Beneath its

upper part is the *short supinator*. These two muscles serve to turn the forearm upon its back—in other words, to supinate it. Under certain circumstances other muscles may assist the supinators. The hand is pronated, that is, turned palm downward, by the *pronator radii teres* and the *pronator quadratus*, the former passing from the inner condyle of the arm-bone to the outer side of the middle of the radius, the latter connecting the ulna and radius at their lower fourths. These muscles are not readily recognized superficially. In the middle of the wrist two tendons are generally prominent : that nearer the thumb is the tendon of the *radial flexor of the wrist*, the other that of the *long palmar* muscle which makes tense the stout fascia in the palm of the hand, and may assist in flexing the wrist. The *ulna flexor* of the *wrist* occupies the extreme ulnar side of the forearm. The last-named three muscles, together with the pronator radii teres, arise together from the inner condyle of the arm-bone, and their fleshy parts make up the superficial part of the forearm on the ulnar side.

Beneath the muscles already described lies the *superficial flexor of the fingers* (flexor sublimis digitorum). It has four tendons, one for each finger, which are inserted into the second bones of the fingers. These tendons are, however, split opposite the first bones, and form arches or grooves through which pass the tendons of the deep flexors of the fingers, which pass forward to the last bones of the fingers. The fleshy part of this deep flexor lies on the ulnar side of the forearm, beneath the muscles previously described.

The thumb is supplied with flexors of its own. The *long flexor* lies beneath the long supinator, below the short supinator ; its tendon being joined to that of the short flexor much in the same manner as in the case of the fingers, and is inserted into the last bone of the thumb.

On the back of the forearm, next to the long supinator, is the *longer radial extensor of the wrist ;* its tendon is inserted into the radial side of the metacarpal bone of the first finger. The *shorter radial extensor* lies just below its fellow, and sends its sinew to the metacarpal bone of the second finger. Down the middle of the back of the forearm runs the *common extensor of the fingers ;* its tendon divides into three parts, and later into four, by the splitting of the one on the ulnar side, and is inserted into the second and third bones of all the fingers ; slips from the tendon bind together, to a certain extent, the bones of the middle, ring, and little fingers. This muscle straightens the fingers when bent, and by contracting strongly, will bend them backward. Beside it, to the inner side, is the *extensor of the little finger*. Its tendon unites with that from

the common extensor. Still farther inward, and forming the ulnar border of the forearm, is the *ulnar extensor of the wrist;* its tendon is inserted into the metacarpal bone of the little finger. The three last-named muscles have origin by a common tendon from the outer condyle of the arm-bone, just as the flexors and pronators arise from the inner condyle. The thumb has three extensors; they lie deep in the back of the forearm, and their tendons are attached to the metacarpal bone and the first and second phalanges of the thumb. The forefinger has likewise a special extensor lying deep in the forearm, and sending its tendon to join the tendon of the common extensor going to the index finger. All the tendons that pass from the forearm into the hand are bound down at the wrist by the *annular ligament,* a strong fibrous band encircling the wrist. Between the ligament and the bones are a number of canals for the passage of the tendons, some containing but one tendon, others two or three.

The muscles of the *hand* are divided into those of the thumb, those of the little finger, and those of the palm. The "ball of the thumb" is made up of four muscles. Just beneath the skin is the *abductor of the thumb,* that draws the thumb outward from the hand; to the outside of this the *opposer of the thumb,* which draws the thumb somewhat inward; to the inner side lies the *short flexor of the thumb;* and deeper down the *adductor of the thumb,* which draws the thumb towards the hand. The muscles on the ulnar side are the *short palmar* muscle, the *abductor,* the *short flexor,* and the *opposer of the little finger.* Between the bones of the hand are two groups of muscles; those on the back spread the fingers apart, those on the palmar side bring them together.

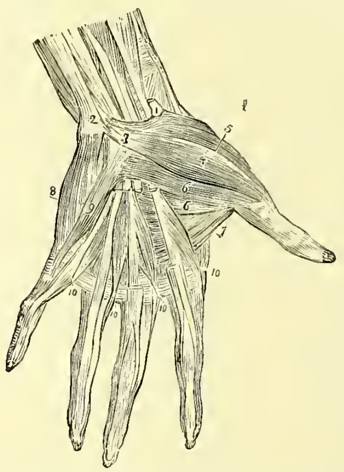


FIGURE 47.—Outer layer of muscles and tendons in the palm of the hand: 1, tendon of the radial flexor of the wrist, cut short; 2, tendon of the ulnar flexor of the wrist; 3, anterior ring-like ligament; 4, 5, 6, 7, muscles which move the thumb; 8, 9, muscles which abduct and bend the little finger; 10, the small worm-like (lumbrical) muscles which aid in folding the fingers onto the palm.

In the great number of muscles attached to the upper extremity will be found the explanation of its varied movements, and particularly of those of the hand. The ball and socket joint of the shoulder gives not only great freedom to this articulation and range to the whole extremity, but greatly assists the motions of rotation of the hand. If the elbow be fixed against the body, and the hand be pronated and supinated,

it will be seen that the rotation is equal to rather more than half a circle, say 100°. But when the elbow is not fixed and the shoulder is allowed to assist in the rotation, there is a gain of another half circle, the whole amounting to more than a complete circle. The elbow is a simple hinge-joint, but one constantly in use. The rotation of the radius upon the ulna, has already been described. The wrist-joint is capable of flexion towards the palmar side to the amount of a right angle and backward to nearly half as great an angle. Besides, the hand can be drawn to the inner and outer sides. The flexion of fingers, singly or together, and the ability to bring them together or to separate them, gives great grasping power and delicacy of movement in a multitude of ways. But the most remarkable power of the hand arises from the unique ability of opposing the thumb to the fingers in such a manner, that the end of the thumb can touch any part of the palmar surface of the fingers. The more the movements of the hands are studied, the more wonderful do they appear, and the hand, as a whole, has been thought worthy of extended discussion in a celebrated work by Sir Charles Bell.

Muscles of the Lower Extremities.

The muscles of the lower extremities include those of the hip, thigh, leg, and foot, and the flexors of the thigh arising within the cavity of the trunk.

The flexors of the thigh are the *great psoas* and the *internal iliac* muscles. The former arises from the sides of the last dorsal and all the lumbar vertebræ, the latter from the great hollow on the inside of the haunch-bone. The two muscles have a common tendon which is inserted into the lesser trochanter of the thigh-bone. This compound muscle raises the thigh and rolls it a little outward ; or, if the thighs are fixed, it bends the small of the back forward.

The muscles of the *hip* are the three *gluteals,* the two *obturators,* the two *gemelli,* or twin muscles, the *pyriformis,* and the *quadratus femoris.* The bulk of the buttock is made up of the *great gluteal,* which arises from the back part of the crest of the ilium and the surface of the bone below, from the sacrum and adjacent ligaments, and is inserted into the back of the upper part of the thigh-bone, below the great trochanter. It is a very powerful muscle. The *middle gluteal* arises from the ilium farther forward, but is partly covered by the great gluteal. It is inserted into the outer side of the great trochanter. The *lesser gluteal* lies under the middle gluteal, and is inserted into the front of the greater

trochanter. All the other muscles extend in a direction nearly horizontal between the bones of the pelvis and the greater trochanter.

The gluteal muscles all move the thigh outward, the anterior part of them roll it inward, the posterior part roll it outward. The lesser and middle gluteals draw the thigh forward and up, the greater gluteal draws it backward and straightens it. They all, acting together, steady the trunk on the thighs, and raise the trunk from a stooping posture. The other muscles roll the thigh outward, or draw it outward, if in a sitting posture.

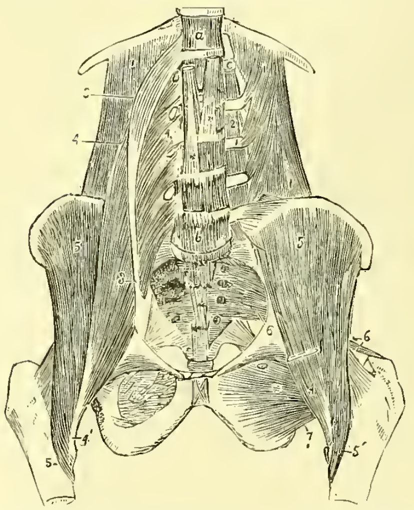
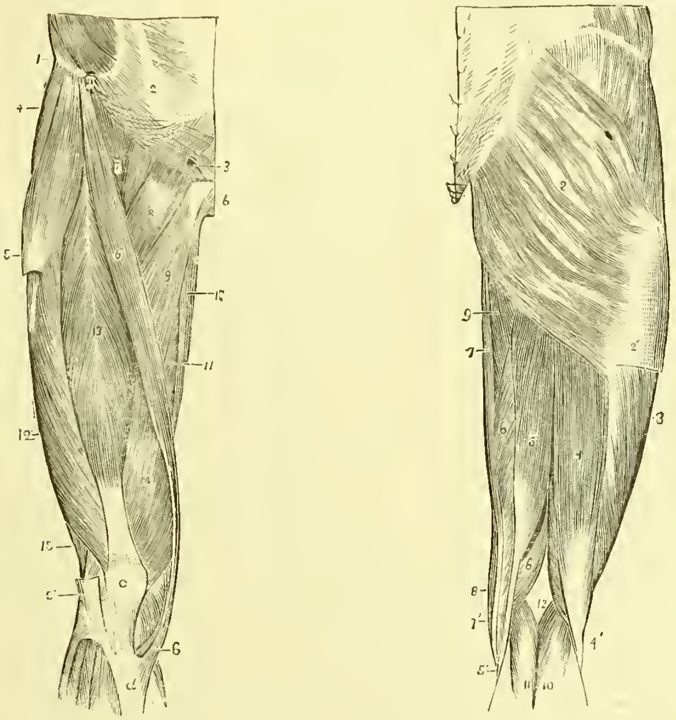


FIGURE 48.—Deep muscles of the abdomen and pelvis: *a*, twelfth dorsal vertebra; 3, the lesser psoas muscle and its tendon inserted into the brim of the pelvis; 4, 4′, great psoas muscle and its tendon inserted into the lesser trochanter of the thigh-bone; 5, 5′, internal iliac muscle and its insertion into the thigh-bone; 6, 6′, the pyriform muscle arising from the front of the sacrum and inserted into the great trochanter of the femur; 7, the external obturator muscle; *, *, the two pillars of the diaphragm.

The muscles of the *thigh* proper are for the most part large and strong. They are encased in a stout fibrous sheath called the *broad fascia*, which extends from the top of the haunch-bone to the knee-joint. The tension of the fascia is, on occasion, increased by the action of the great gluteal, which is connected with it, and by a small muscle arising from the crest of the ilium, which runs into the fascia, and is called the *tensor of the sheath of the thigh.*

The longest muscle in the body is the *sartorius*, or tailor's muscle, so called because its action is to crook the lower limb as does a tailor when he sits cross-legged. It arises from the prominent point (anterior superior spinous process) of the haunch-bone, and crossing the thigh obliquely is inserted into the inner side of upper part of the shin-bone. The front of the thigh is made up of the great *four-headed extensor.* The muscle is called four-headed, because it is composed of the *rectus*, or straight muscle, which occupies the middle of the thigh, the *inner and outer vasti* lying at either side and wrapping around the thigh-bone, and of the *crureus*, which is essentially a part of the internal vastus. All these masses of muscular tissue have a common tendon which is inserted into the knee-pan, although properly speaking the tendon is inserted into the tuberosity of the shin-bone, the knee-pan being but a bony development in the tendon.

The inner side of the thigh contains the three *adductors* of the thigh, the *great*, the *long*, and the *short*. The origin of these muscles is from the front of and the descending branch of the pubes. They all expand fan-wise as they approach the thigh-bone, the great adductor extending its insertion the entire length of the shaft of the thigh-bone; the short adductor is inserted into the up-

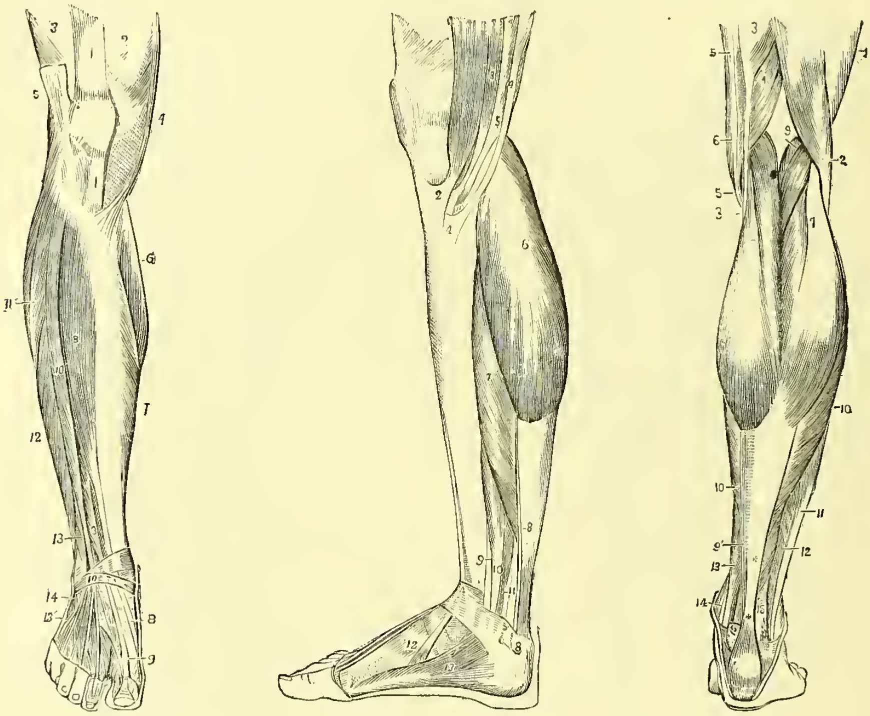


FRONT. REAR.

FIGURE 49.—Muscles of the thigh.—FRONT: *a*, anterior part of the crest of the haunch-bone; *b*, symphysis pubis; *c*, patella; *d*, commencement of the ridge of the shin; 1, hip-bone; 2, the broad tendon of the external oblique muscle; 3, external abdominal ring; 4, part of the middle gluteal muscle; 5, the tensor vagini femoris or tensor of the sheath of the thigh; 6, sartorius; 7, psoas and iliacus muscles; 8, pectineus; 9, long adductor; 10, gracilis; 11, part of the great adductor; 12, the external vastus muscle; 13, rectus or straight muscle of the thigh; 14, internal vastus muscle; 15, small portion of the biceps muscle of the thigh. REAR: 1, middle gluteal; 2, great gluteal; 2′, its insertion into the broad fascia, which has been cut away; 3, external vastus; 4, biceps; 5, semitendinous muscle, 6, semimembranous muscle; 7, gracilis; 8, a small portion of the sartorius; 9, a small portion of the great adductor; 10, 11, outer and inner heads of the gastrocnemius muscle; 12 is placed in the popliteal space.

per third of the bone and the long adductor into its middle third. Besides, there are in this region the *pectineus* muscle, running from the pubis to the upper part of the back of the shaft of the thigh-bone, and the *gracilis*, a slender muscle which forms the extreme inner side of the thigh, extending from the pubes to the upper part of the shin-bone.

The back of the thigh is made up of the hamstring muscles. The outer hamstring is the tendon of the strong *biceps* muscle which arises from the seat-bone and the thigh-bone. This tendon is in-



FRONT. INNER SIDE. REAR.

FIGURE 50.—Muscles of the leg.—FRONT: 1, tendon of the rectus; 2, 3, lower parts of the two vasti muscles; 4, lower end of sartorius; 5, small portion of the fascia lata cut near its attachment at the knee; 6, inner head of the gastrocnemius; 7, inner part of the soleus; 8, 8, anterior tibial muscle and (below) its tendon near its insertion; 9, part of the long extensor of the great toe and its tendon; 10, the long common extensor of the toes; 11, long peroneus; 12, short peroneus; 13, tendon of the third peroneus; 14, origin of the short common extensor. INNER SIDE: 1, part of the internal vastus; 2, tendon of the sartorius; 3, gracilis; 4, semitendinous muscle; 5, semimembranous muscle; 6, inner head of the gastrocnemius; 7, soleus; 8, tendon of Achilles (the small tendon of the plantar muscle, passes down on its inner border); 9, a small part of tendon of posterior tibial; 10, common flexor of the toes; 11, the dark portion to the left is the long flexor of the great toe; 12, a narrow part of the anterior tibial; 13, abductor of the great toe; across the ankle above the instep is shown the ring-like ligament under which these tendons pass and which binds them in place. REAR: 1, lower part of external vastus; 2, lower part of biceps; 3, lower part and tendon of the semitendinous muscle; 4, lower part of semimembranous muscle; 5, gracilis; 6, a small part of the sartorius; 7, 8, outer and inner heads of the gastrocnemius; 9, placed in the popliteal space, points to the plantar muscle; lower down 9′ points to its thin tendon to the left of the tendon of Achilles; 11, tendon of the long peroneal; 12, lower fibers of the short peroneal; 13, lower part of the long flexor of the toes; 14, small portion of the tendon of the posterior tibial; 15 is placed on the lower end of the fibula.

serted into the head of the fibula, or splint-bone—the smaller bone of the leg. The inner hamstring is made up of the *sartorius* and *gracilis*, already described, and the *semi-tendinosus* and the *semi-membranosus*. These last arise from the seat-bone, and are insert-

ed into the inner side of the upper part of the shin-bone. The hamstring muscles flex the leg upon the thigh; the biceps also twists the leg outward, and the semi-membranosus slightly inward.

On the inner side of the *leg* the shin-bone lies just beneath the skin, but its outer aspect is covered for about two-thirds of its length by the belly of the *anterior tibial* muscle. The tendon of this muscle is inserted into the head of the first metatarsal bone, and into the under part of the internal cuneiform bone. Its tendon can be felt crossing in front of the ankle to the hollow of the foot. If the structure of the bony arch is remembered it will be at once seen that this muscle supports this arch; it further raises the front of the foot and rolls its inner border upward. Next outside of the anterior tibial is the *long extensor of the toes,* with four tendons arranged in the same manner as the extensor of the fingers. The *peroneus tertius* is essentially a part of this muscle, its tendon going to the fifth metatarsal bone. Between and beneath the two previously described muscles is the *proper extensor of the great toe.*

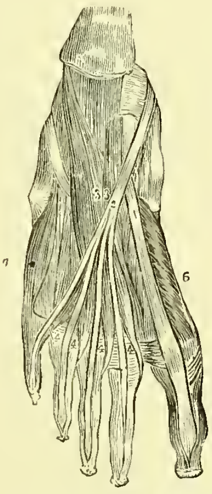


FIGURE 51.—Middle layer of muscles of the sole of the left foot: 1, tendon of the long flexor of the great toe; 2, tendons of the deep common flexor of the toes; 3, two heads of the accessory flexor of the toes; 4, the four "worm-like" muscles; 6, the short flexor of the great toe; 7, short flexor of the little toe.

The back of the leg, or calf, is made up of the *gastrocnemius* and *soleus* muscles, which have a common tendon, the *tendo Achillis,* or heel-cord. The gastrocnemius arises by two heads from the back part of the condyles of the femur; the soleus lies beneath the gastrocnemius, arising from the back part of the shin and splint-bones. Their stout common tendon is inserted into the bone of the heel. This combined muscle raises the heel and is used in walking, jumping, etc. In standing it steadies the thigh upon the leg. Deeper in the calf lie the *long flexor of the great toe* to the outside, the *long flexor of the toes* to the inside, and between them the *posterior tibial* muscle. The two former go to the toes in a manner similar to that described when speaking of the flexors of the fingers. The posterior tibial is inserted into the scaphoid bone. On the outer side of the leg lie the *long and short peroneals,* the former being inserted into the base of the metatarsal bone of the great toe, the latter into that of the little toe. It will be noticed that the tibials and the peroneals have an action analogous to that of the flexors and extensors of the wrist. The anterior tibial and the peroneus tertius

are flexors of the foot; the posterior tibial and the long and short peroneals are extensors of the foot. If opposing muscles on the same side of the foot act at the same time, the foot will be turned to that side; thus the two tibials throw the foot inward, the peroneals, especially the long one, turn it outward.

The sole of the *foot* contains the strongest of all the fibrous membranes, the *plantar fascia*, namely. It has a very strong central portion arising from the heel-bone, and running forward splitting into slips, one for each toe; the lateral portions are less strong. This fascia covers in the muscles, vessels, and nerves of the sole, and protects them from injury; it also ties together the arch of the foot and helps to give it the strength necessary to sustaining the weight of the body (see Fig. 34). On the back of the foot is but one muscle, the *short extensor of the toes*, which is simply an assistant of the long extensor, being inserted into the tendon of the latter, except in the case of the great toe.

Immediately beneath the plantar fascia lies the *short flexor of the toes*, with four tendons. These are inserted into the second phalanges; are perforated by the tendons of the long flexor, as those of the superficial flexor of the hand are perforated by those of the deep flexor. To the inner side of the short flexor lies the *abductor of the great toe*, to the outer side the *abductor of the little toe*. Deeper in the foot are two other layers of muscles, for the most part bearing similar names to those in the hand, and being chiefly concerned in moving the toes.

THE ARTERIAL SYSTEM.

"The arteries are cylindrical, tubular vessels, which serve to convey blood from both ventricles of the heart to every part of the body."

The arterial system is often compared to a tree: as the main trunks give off branches, these again smaller branches, and so on, until the smallest are reached, which empty into the capillary network. The arteries are strong and elastic, and are firm enough in structure to remain open when empty. They have three coats, all more or less elastic, the middle one containing muscular fibres of the involuntary variety. There is no uniformity in the branching of arteries; in one place the trunk divides into two branches, in another into several. They branch, too, at all sorts of angles. Branches, still further, often unite, forming what is called an anastomosis. Arterial trunks, as a rule, run in a tolerably straight direction, from point to point, but are occasionally winding.

The smallest arteries, with few exceptions, terminate in a net-

work of very small vessels, about $\frac{1}{3000}$ of an inch in diameter, called capillaries. The closeness of the net-work varies in different parts of the body according to the amount of blood needed.

The whole number of arteries of sufficient importance to have received a specific name is very great, about five hundred in all, but a few only have especial interest to the general reader. The

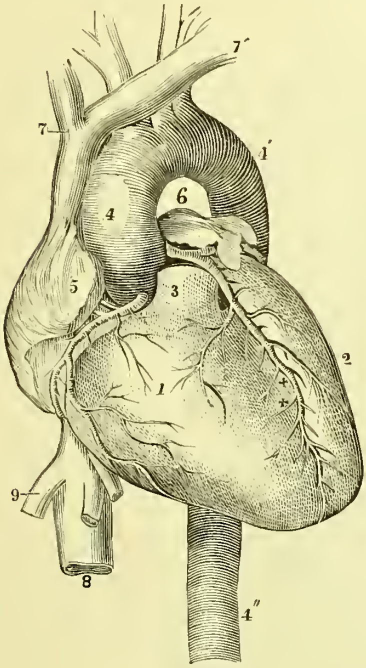


FIG. 52.

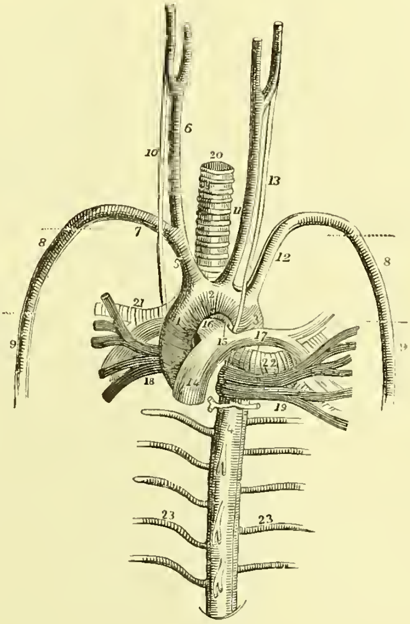


FIG. 53.

FIGURE 52.—The heart and its arteries seen from in front. The pulmonary artery (3) has been cut short. 1, anterior part of right ventricle; 2, left ventricle; 3, root of pulmonary artery; 4, 4′, 4″, the aorta; 5, part of right auricle; 6, part of left auricle; 7, 7′ right and left veins which unite to form the upper vena cava; 8, lower vena cava; 9, one of the hepatic veins; *, *, left or anterior coronary artery.

FIGURE 53.—1, 2, 3, arch of the aorta; 4, thoracic aorta; 5, innominate artery; 6, right carotid; 7, right subclavian; 8, axillary; 9, the brachial; 10, pneumogastric nerve on the right side; 11, left carotid; 12, left subclavian; 13, left pneumogastric nerve; 14, 15, pulmonary artery; 16, 17, its branches going to the lungs; 18, 19, pulmonary veins; 20, trachea; 21, 22, the large bronchial tubes; 23, 23, intercostal (between the ribs) arteries.

principal arterial trunk of the body is called the *aorta*. It arises from the upper part of the left ventricle, and rising a short distance, arches backward and to the left side of the spinal column, passes through the diaphragm into the abdomen, and opposite the fourth lumbar vertebra ends by dividing into the common iliac arteries.

The arch of the aorta gives off in its short course very impor-

tant arteries. The first are *Coronary* arteries which supply the heart itself. Just as the top of the arch is reached, is given off or the right side the *innominate* artery, a very large vessel, which, after a course of from an inch and a half to two inches, divides int the right *carotid* and *subclavian* arteries. From the left side of the top of the arch is given off the left carotid, and still farther to the

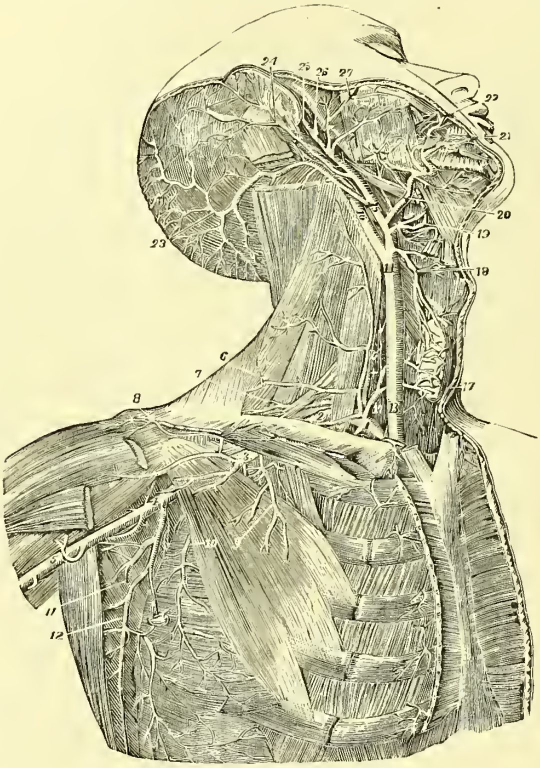


FIGURE 54.—Deep view of the carotid, subclavian, and axillary arteries and their branches; the large muscles in the front of the neck and chest having been divided or removed: 1, subclavian artery; *, vertebral artery; 3, 4, axillary artery; 5, commencement of the brachial artery; 6, 7, 8, branches going to the shoulder; 9, branch going to the pectoral muscle; 10, long thoracic artery; 11, 12, subscapular artery; 13, 14, common carotid artery; 15, external carotid artery; 16, internal carotid artery; 17, 17, thyroid axis and thyroid gland; 18, upper thyroid artery; 19, lingual artery; 20, facial artery; 21, inferior labial; 22, coronary artery; 23, occipital artery; 24, posterior auricular artery; 25, superficial temporal artery; 26, internal maxillary artery; 27, transverse facial artery.

left the left subclavian. Except for the first two or three inches, the course of these vessels is very nearly the same as those on the opposite side. The carotids run up the neck, taking a course along the front of the sterno-cleido-mastoid muscle. When about opposite the "Adam's apple" they divide into two main branches, the *external* and *internal carotids.* The former runs with a slight

curve forward towards the joint of the lower jaw, giving off on its way many large branches, besides several smaller ones. The more important ones are: the *superior thyroid*, supplying, by its branches, the front part of the neck and upper part of the windpipe; the *lingual*, supplying the tongue from beneath; the *facial*, which crosses the lower jaw and is distributed to the lips, chin, and lower part of the cheeks; the *occipital*, which sends branches to the back part of the scalp and neck. The external carotid ends by division, just below the lobule of the ear, into the *temporal* and the *internal maxillary*. The former branch continues upward and slightly forward in front of the ear, and divides on the side of the head into the *posterior* and *anterior temporal*, which supply the side and front of the scalp as far forward as the eyebrows. The *internal maxillary* is a larger vessel which dips down beneath the upright portion of the jaw, and sends branches to the jaw, the deep structures of the face, and into the cavity of the skull.

The *internal carotid*, after its separation from the external carotid, continues up the neck in nearly the same direction as the common vessel, close to the spinal column, and enters the cavity of the skull through an aperture lying just in front of the apparatus of hearing. Within the skull it sends small branches to the ear, a large branch (the *ophthalmic*) to the eye and its neighborhood, and to the anterior part of the brain two large branches: the *anterior* and *middle cerebral*.

The *subclavian* artery, so called from its position under the clavicle, in the main sends its blood to the upper extremity. It is really one trunk from its origin to the elbow; but the name subclavian is given only to that part between the origin and the outer border of the first rib; in the armpit it is called the *axillary*; in the arm, the *brachial*. The subclavian proper sends off, near its origin, the *vertebral* artery, which passes through openings in the transverse processes of the upper six vertebræ, and entering the skull supplies the posterior part of the brain, its branches anastomosing with those from the internal carotid, so as to keep up a very free supply of blood to all parts of the brain. The next branch is a short trunk called the *thyroid axis*, which sends branches to the front of the neck, to the back of the shoulder and the shoulder-joint and its neighborhood. Another branch is the *internal mammary*, which is distributed within the chest and to the respiratory muscles.

The branches of the *axillary* artery are sent to the chest-wall and to the arm, winding around the neck of the arm-bone. When the axillary artery reaches the outer margin of the armpit, it becomes the *brachial*. This vessel runs a nearly straight course to

the bend of the elbow. It lies just to the inner side of the biceps muscle. All the branches of the vessel are distributed to the arm.

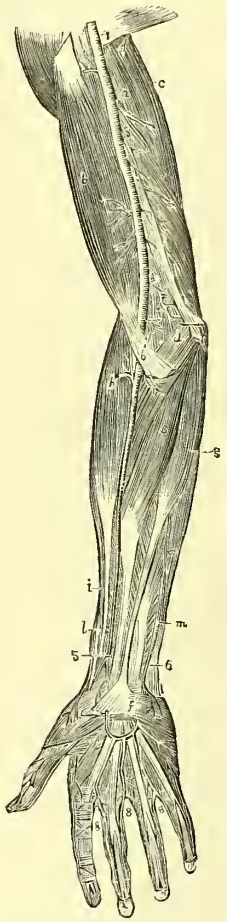


FIGURE 55.—Arteries of the arm, forearm, and hand; the letters refer to muscles: *b*, biceps; *c*, head of the triceps; *d*, radial pronator; *e*, radial flexor of the wrist; *f*, long palmar; *g*, ulnar flexor of the wrist; *h*, long radial supinator; *i*, long radial extensor of the wrist; *l*, extensor of the metacarpal bone of the thumb; *m*, common superficial flexor of the fingers.
1, lower part of axillary artery; 2, upper profunda; 3, lower profunda; 4, ulnar anastomosing artery; 5, lower end of radial artery; 6, lower end of ulnar artery; 8, the digital arteries given off from the superficial palmar arch and going to the fingers.

Just below the bend of the elbow the vessel divides into the *radial* and *ulnar* arteries. The former, in its derivation, seems to be a continuation of the brachial along the inner margin of the long supinator muscle. When it reaches the wrist it twists around the side of the wrist so as to enter the palm of the hand from behind, between the heads of the metacarpal bones of the thumb and first finger. In the palm it forms the *deep* palmar arch. In the arm the *radial* sends branches to the muscles; in the wrist, branches to the hand, and back of the thumb and forefinger; and from the palmar arch arise branches going to the thumb and radial side of the forefinger and hand. The pulsation of this vessel, just before it makes the turn towards the back of the wrist, is ordinarily used to ascertain the rapidity of the heart's action by "feeling the pulse." (No. 5 in Fig.)

The *ulnar artery*, somewhat larger than the radial, crosses beneath the superficial flexor muscles to the ulnar side, and then runs just to the outer side of the ulnar flexor of the wrist, crosses the annular ligament, and forms the *superficial* palmar arch. Its branches in the forearm pass between the bones and supply the muscles of the arm and forearm. Lower down it sends branches to the front and back of the wrist. From the superficial arch are sent vessels to the ulnar side of the forefinger, and to the other fingers, the vessels dividing into branches, one for each side of the finger.

The *thoracic aorta* is that part of the aorta included between the lower border of the third dorsal vertebra and the diaphragm. At its beginning it is to the left of the spinal column, but approaches the middle of the column as it descends, lying directly in front of it on passing through the diaphragm. Its branches go to the lungs, the gullet, and to the walls of the chest, there being gen-

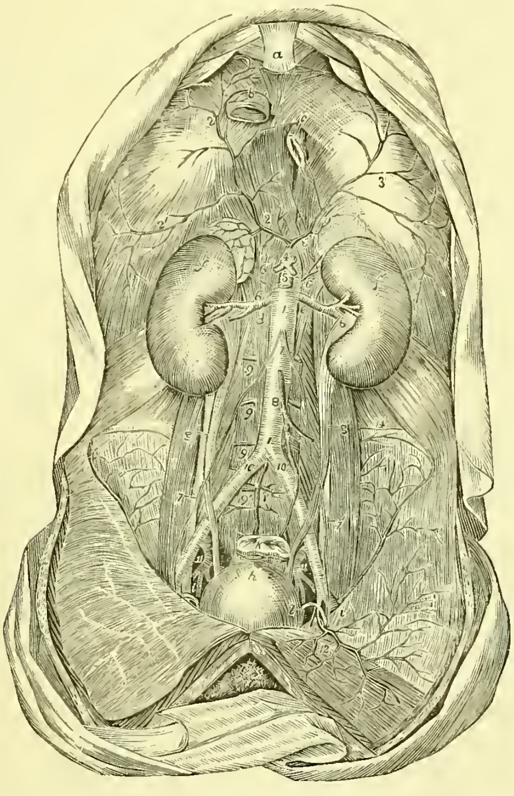


FIGURE 56.—Tbe abdominal aorta and its principal branches: *a*, end of breastbone; *b*, ascending vena cava cut off below tbe diapbragm; *c*, œsophagus also cut off below the diaphragm; *f*, *f*,′ the rigbt and left kidneys; *g*, *g*′, the ureters; *h*, the bladder; *i*, *i*, the vas deferens on either side; *k*, the divided end of the rectum; 1, 1, the abdominal aorta; 2, 3, the phrenic arteries; 4, trunk of the cœliac axis; 5, superior mesenteric artery cut off; 6, 6, renal arteries; 7 is between the two spermatic arteries; 8, inferior mesenteric artery; 9, lumbar arteries, the lower one is by the side of the sacral artery; 10, common iliac arteries; 11, between the external and internal iliac arteries; 12, left epigastric artery.

erally ten intercostal arteries on each side of the latter. After the aorta has passed through the diaphragm, it is styled the *abdominal aorta.* This sends off a number of vessels. The *phrenic* arteries go to the diaphragm, the *lumbar* arteries, generally four on a side, go to the walls of the abdomen and the *middle sacral* in front of the spine, to its tip, the coccyx. The other branches supply the

organs in the abdomen. First, counting downward, the *cœliac axis*, a stout trunk, half an inch thick, which divides presently into three branches ; the *hepatic*, going to the liver and right end of the stomach ; the *gastric*, to the top of the stomach, and the *splenic*, to the spleen and left end of the stomach. Next, the *superior mesenteric*, supplying nearly all the small intestine, and the ascending and transverse portion of the large intestine. Then the *renal* arteries, two large trunks going to the kidneys. Just above are two small vessels going to the suprarenal capsules. The *spermatic* arteries are two small vessels going to the testicles in the male and to the ovaries in the female. The *inferior mesenteric* supplies the remainder of the large intestine and the greater part of the rectum.

On the body of the fourth lumbar vertebra the aorta divides into the two *common iliacs*, each of which again divides, after a course of about two inches, into the internal and external iliacs. The *internal* iliac is the smaller of the two and is about an inch and a half in length, dividing into two trunks. The anterior trunk supplies the pelvic organs, the genitals, anus, buttock, and upper part of the thigh. The posterior trunk is distributed chiefly to the muscles of the haunch and buttock.

The *external iliac* passes out of the pelvis beneath Poupart's ligament, and is continued under the name of the *femoral artery*. The course of this vessel corresponds nearly to a line from the middle of the groin to the inner side of the inner condyle of the femur. In the upper third of the thigh the vessel is quite superficial; in the middle third it is beneath the sartorius muscle. At the junction of the middle and lower third the femoral artery ends, and passing through an opening in the great adductor muscle it becomes the popliteal artery. Near the groin the femoral gives off several small branches ; one or two inches below Poupart's ligament it gives off the *profunda* or *deep femoral*, a very large artery, which again gives off the *internal* and *external circumflex* vessels (which run around the thigh) and three perforating arteries. At the lower end of the femoral the great *anastomosing* artery is given off.

The *popliteal artery* begins where the femoral ends, and passing downward and slightly outward behind the knee-joint, divides a short distance below into the anterior and posterior tibial arteries. The branches of the popliteal are distributed to the muscles and to the joint.

The *anterior tibial* passes forward between the upper extremities of the bones of the leg, and runs down the leg beneath the fleshy part of the anterior tibial muscle. In the lower third of the

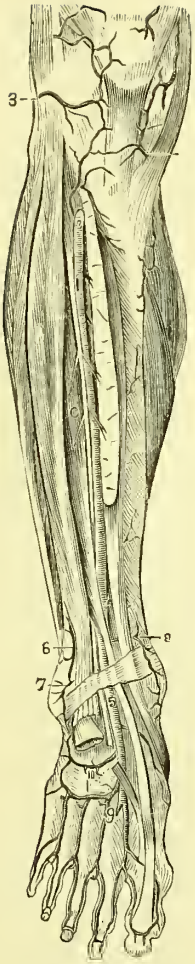


FIG. 57.

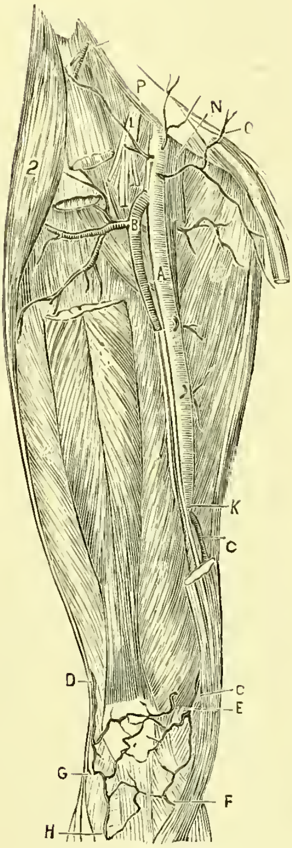


FIG. 58.

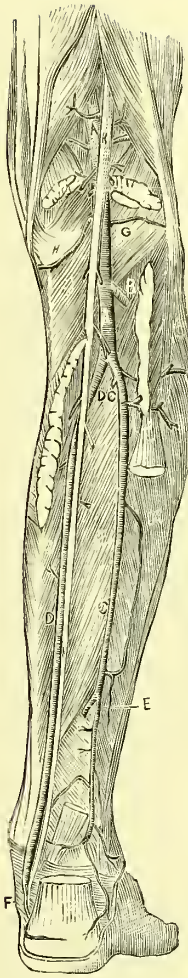


FIG. 59.

FIGURE 57.—Blood-vessels on the front of the leg and foot. 1, Anterior tibial artery; 2, point where it emerges from behind the bones; 3, external communicating artery; 5, dorsalis pedis artery; 6, external malleolar artery; 7, lower end of the fibula; 8, internal malleolar artery; 9, interosseous arteries; 10, tarsal artery.

FIGURE 58.—A, femoral artery; B, profunda or deep artery. The letter is placed at the point where the external pudic artery on the inner side, and the external circumflex artery on the outer side, are given off from the profunda; C, C, the great anastomosing artery; D, E, the outer and inner superior articular branches; F, G, the inner and outer inferior articular arteries; H, the anterior tibial recurrent artery; K, long saphenous nerve; L, anterior crural nerve; N, femoral vein; O, external abdominal ring; P, Poupart's ligament.

FIGURE 59.—The principal arteries and nerve at the back of the leg. A, A, popliteal artery; B, anterior tibial; C, C, peroneal artery; D, D, posterior tibial artery; E, anterior peroneal artery; F, internal calcanean artery; G, H, internal and external inferior articular branches; K, K, posterior tibial nerve.

leg it continues nearly in the middle of the leg, while the tendon of the muscle diverges towards the inner side. Passing upon the foot the vessel takes the name of the *dorsalis pedis.* This last artery gives off tarsal and metatarsal branches, the latter making an arch and sending branches upon the back of the foot and toes in much the same manner as the vessels on the back of the hand are arranged.

The *posterior* tibial runs down the leg beneath the calf-muscles, crossing to the inner ankle, then lying behind the ankle bone. Near this point it divides into the internal and external plantar arteries. The principal branch of the posterior tibial is the *peroneal* artery, which is given off about an inch below the bifurcation of the popliteal ; it crosses over to the fibula and follows its inner edge down to near the ankle, where it breaks up into smaller branches. The *external plantar* artery runs from the end of the posterior tibial obliquely across the sole of the foot to the base of the fifth metatarsal bone ; it then makes an arch across the foot and passes up between the first and second metatarsal bones, to join a branch from the dorsalis pedis. This arch lies deeply in the sole, and gives branches to the toes.

From the right ventricle arises the *pulmonary artery ;* it is a short, wide vessel, about two inches in length, and divides into two large branches—the right and left pulmonary arteries. These both, in their turn, break up into an arterial tree. The pulmonic system of arteries carries the dark, venous blood from the heart to the lungs for its purification.

THE VENOUS SYSTEM

forms a tree with branches distributed to every part of the body, similar to the arterial tree. The current of blood, however, flows in an opposite direction, *i.e.*, from branch to trunk, and eventually to the auricles of the heart. The veins are larger and more numerous than the arteries. They are less firm in structure, are not always round, and when not filled with blood collapse. Communications between vessels, which are only occasional in arteries, are very common in veins. The veins are furnished with valves at short intervals which prevent the flowing backwards of the blood when its course is obstructed

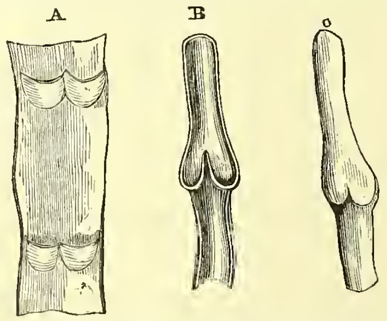


FIGURE 60.—Diagrams showing the valves of veins. A, part of a vein cut open and spread out, showing two pairs of valves. B, longitudinal section of a vein showing the way in which the edges of the valves come in contact. C, portion of a distended vein, showing a swelling at the situation of a pair of valves.

by the contraction of a muscle or in any other way. The free communication of the veins then permits the escape of the blood in other directions. These communications are most free in situations where obstruction to the flow of the blood would be dangerous or injurious.

The veins are generally divided into the superficial veins, those which lie just beneath the skin; the deep veins which generally accompany the arteries; and the sinuses. The smaller arteries like those of the arm, generally have two accompanying veins, one on either side; the larger vessels, like the femoral or axillary, have usually but one. The sinuses are not strictly veins, but great canals for venous blood formed within the skull by division of the lining membrane—the dura mater. Like the arteries, the veins have three coats, which become thinner as the veins are smaller.

Veins of the Head.

The veins upon the exterior of the head in a general way correspond in situation to the arteries of that region and bear similar names, for instance, the temporal, the facial, the internal maxillary, and the occipital.

The principal veins of the neck are the *external jugular* and the *internal jugular*.

The external jugular receives the blood from most of the veins just mentioned as coming from the head, together with that from some smaller vessels. It begins in the parotid gland behind the angle of the jaw, and runs down the neck toward the middle of the collar-bone. It empties into the subclavian vein. The *internal jugular* lies a little deeper, receives blood from the cavity of the skull and from some parts of the face and neck. It arises at an aperture in the base of the skull just behind that where the carotid enters, and running down the neck joins with the subclavian vein to form the innominate vein. The two innominates unite to form the superior vena cava.

FIGURE 61.—The superficial veins of the head and neck. 1, sterno-mastoid muscle; *f* and *k*, external and internal jugular veins.

The skull contains many veins in the soft structure between its

hard walls. The sinuses are arranged on the base of the skull in a form very much like a common jews-harp, the rounded part behind and enclosing the foramen magnum, the straight part running forward to the eyes. Another, called the superior longitudinal sinus, occupies the middle line of the arch of the skull from the occiput to the root of the nose; there are besides several smaller ones.

Veins of the Upper Extremity.

The veins of the upper extremity are, beside those accompanying the arteries, on the ulnar side, an anterior and posterior vein, a radial vein along the radial margin of the forearms, and between it and the anterior ulnar the median vein. The ulnar veins unite to form the basilic vein, which runs from the inner side of the elbow to the axilla. The radial empties into the cephalic vein, which runs from the elbow along the outer side of the biceps muscle, and, curving around the inner margin of the deltoid, goes to the axillary vein. At the bend of the elbow the basilic and cephalic are connected by a V-shaped vessel, one arm of the V being called the median cephalic, the other the median basilic vein. Into the point of the V empties the median vein, together with a vein from the deeper tissues. This is the part generally chosen for bleeding, and the median cephalic vein is the most convenient one. The relation of the median basilic to the brachial artery renders it a less safe vessel to operate upon. The axillary vein is the continuation of the basilic and accompanies the axillary artery. It is itself continued under the name of the subclavian vein.

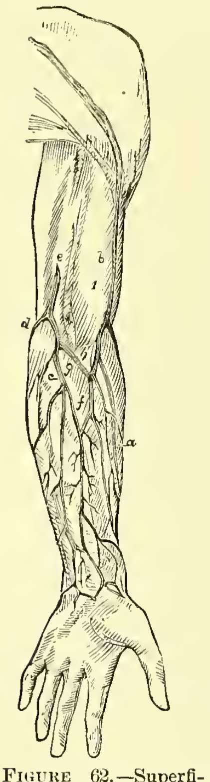


FIGURE 62.—Superficial veins of the arm and forearm. 1, biceps muscle; *a*, radial veins; *b*, cephalic vein; *c*, ulnar veins; *d*, posterior ulnar vein; *e*, basilic vein; *f*, median vein; *g*, median basilic vein; *h*, median cephalic vein.

The spinal canal contains a network of veins extending the entire length of the canal.

Veins of the Lower Extremity.

The lower extremity has, like the upper, both deep and superficial veins. The superficial veins are the internal or long saphenous, and the external or short saphenous.

The *long saphenous* commences from a large number of small

veins on the top and inside of the foot, passes up along the inner side of the shin-bone, behind the inner condyle of the femur, and just below the groin passes through an opening in the broad fascia, called the saphenous opening, to join the femoral vein. The *short saphenous* arises from the outer side of the foot, passes behind the outer ankle obliquely to the middle of the calf and thence to the popliteal vein in the back of the knee. The *popliteal* receives also blood from the deep veins ; after it reaches the ring in the great adductor it is called the *femoral*, like the artery which

FIG. 63.

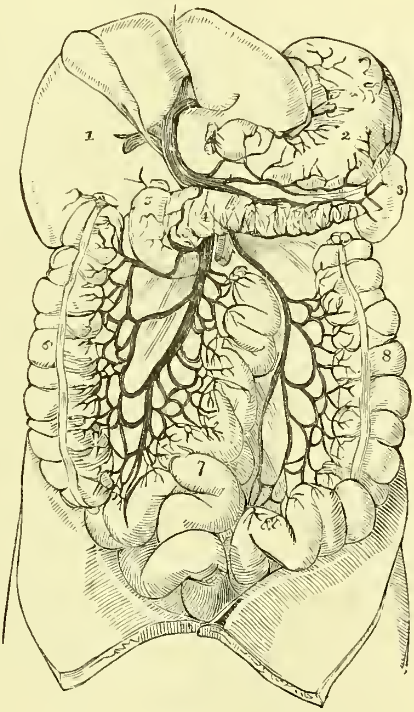


FIG. 64.

FIGURE 63.—Outline of the principal superficial veins of the lower limb.

FIGURE 64.—Principal branches of the portal veins. 1, lower surface of the right lobe of the liver ; 2, stomach ; 3, spleen ; 4, pancreas ; 5, duodenum ; 6, ascending colon ; 7, small intestines ; 8, descending colon.

it accompanies. The femoral receives the long saphenous, the profunda, and other smaller branches, and on reaching the groin becomes the *external iliac* vein. The *internal iliac* vein drains the parts supplied by the artery of the same name.

Around the lower end of the bowel is a net-work of veins called the *hemorrhoidal plexus,* made up of branches of the superior,

middle and inferior hemorrhoidal veins ; the former emptying into the inferior mesenteric vein, and the latter two into the internal iliac. This plexus is of interest as being the seat of the disease known as hemorrhoids, or piles. It will be easily seen that any pressure upon the larger trunks above would be likely to cause dilatation of this plexus. The internal iliac joins the external to

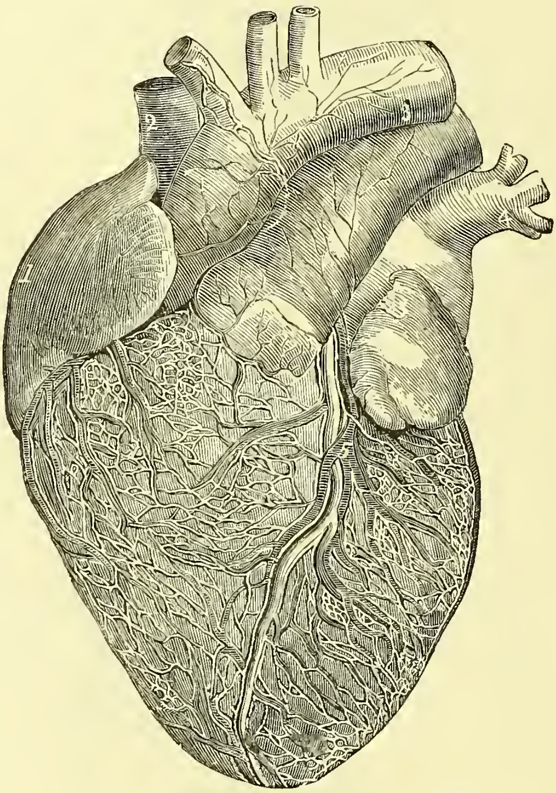


FIGURE 65.—Arteries and veins of the heart.

form the *common iliac* vein. The two common iliacs join to form the *ascending vena cava.* As the cava ascends along the right side of the spinal column, it receives several veins, chief among them the *renal* veins which enter at a right angle. The inferior and superior mesenteric veins, and the splenic and gastric veins, do not directly enter the trunk of the vena cava. The inferior mesenteric empties into the splenic ; their common trunk joins the superior mesenteric to form a large trunk called the *vena portæ,* or portal vein ; the portal vein also receives the veins from the stomach. The trunk of the portal vein enters the liver through the trans-

verse fissure in its under surface, and then redivides ; its ramifications accompanying those of the hepatic artery and the hepatic duct throughout the liver. From the capillaries this blood is again gathered by the branches of the hepatic vein and returned to the vena cava.

The veins of the heart lead into the right auricle either directly or through a large vein on the back of the left heart, called the coronary sinus.

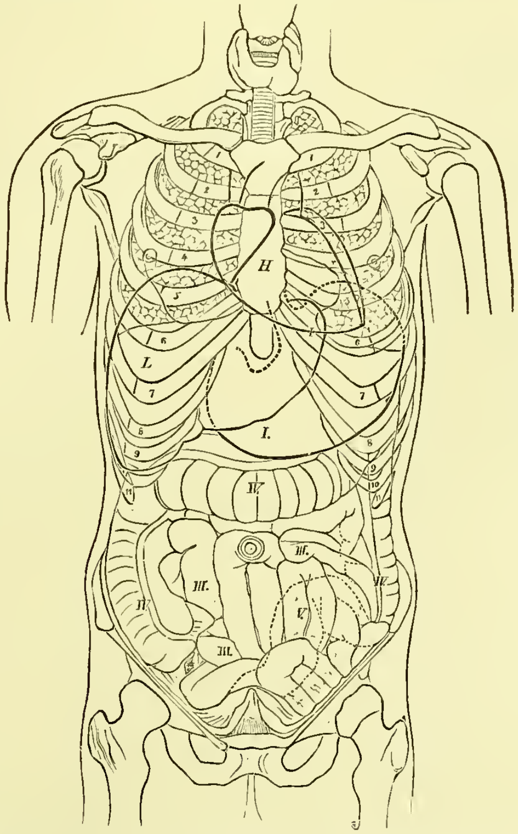


FIGURE 66.—Diagram showing in outline the location of the heart and its relation to other organs in the chest and abdomen. I., the stomach; II., commencement of large intestine; III., small intestine; IV., transverse and descending portions of the large intestine; V. (dotted lines), the rectum; the numbers 1 to 11 indicate ribs; H, the heart; L, the liver.

The *pulmonary* veins are four, two for each lung, and have the notable peculiarity of carrying arterial blood from the lungs to the left auricle.

Having spoken of the channels for conveying the blood, it remains, before describing the circulation, to speak of the central motor organ.

The Heart.

This is a hollow muscular organ of a conical form. It is situated in the chest between the lungs, and is placed rather obliquely, so that its base is upwards, backward, and to the right. The base corresponds to the space between the fifth and eighth dorsal vertebræ, while the point or apex is directed forward and to the left, corresponding to the interval between the fifth and sixth ribs. The heart extends about an inch and a half to the right of the central line of the breastbone, and about three inches to the left. The anterior surface is rounded, the posterior, lying upon the diaphragm, is more flattened. In an adult it is about five inches long, three and a half wide at the widest, and two and a half thick, and weighs ten to twelve ounces in a man, and about two ounces less in a woman. The heart is divided in the middle by a vertical partition called the septum, into two parts called the right and left hearts or sides of the heart; each side is again divided by a transverse constriction or perforated partition. The cavities above these partitions at the base of the heart are called the right and left *auricles;* those below, the right and left *ventricles.* The right side contains dark or venous blood, and the left side red or arterial blood. The auricles are much thinner than the ventricles, the latter being made up of muscular tissue capable of very considerable propelling force.

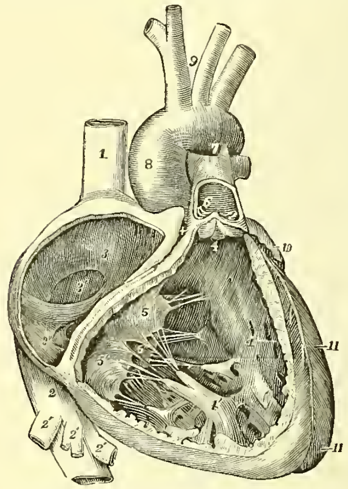


Figure 67.—The right auricle and ventricle opened, part of their walls being removed so as to show their interior. 1, the superior vena cava; 2, the inferior vena cava; 2′, the hepatic veins cut short; 4, 4, the cavity of the right ventricle; 4′, a large columna carnea or fleshy pillar; 5, 5′, 5″, the three portions of the tricuspid valve with the tendonous cords which support them going to the columna carnea; 6, placed in the interior of the pulmonary artery; 7, ductus arteriosus; 8, the commencement of the aorta; 9, placed between the innominate artery and left common carotid artery; 10, appendix of the left auricle; 11, 11, portion of the left side of the heart.

The two main veins of the body empty into the *right ventricle;* these veins are the *superior vena cava,* bringing blood from the upper part of the body, and the *inferior vena cava,* larger than the other, bringing blood from the lower part of the body. In the floor of the auricle is an oval opening about one inch in diameter, leading into the right ventricle. This opening is closed by a valve called from its three parts the *tricuspid valve,* which opens to-

ward the ventricle. The *right ventricle* has a stout muscular wall. From the inner surface of the wall spring off numerous fleshy columns, or *columnæ carneæ,* from some of which arise certain *tendinous cords* which are inserted into the valves to give them support. The cavity of the right ventricle will contain about two fluid ounces, or four tablespoonfuls, of liquid. In the upper and anterior wall of the ventricle is another opening leading into the pulmonary artery. This orifice is furnished with two *semilunar valves* which open into the artery.

The *left auricle* is rather smaller and thicker than the right, its

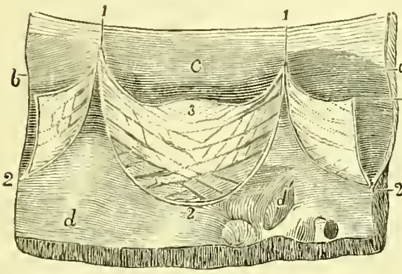


Fig. 68.

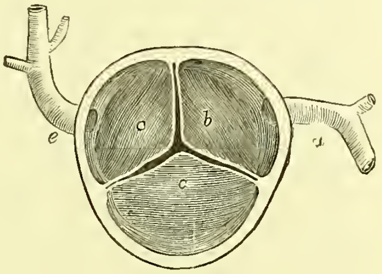


Fig. 69.

Figure 68.—Portion of the pulmonary artery and wall of the right ventricle, with one entire segment and two half-segments of the semilunar valve: *a*, half of a sinus of Valsalva, or pocket; *b*, the other half of the same sinus; *c*, an entire segment; *d*, *d′*, the inner surface of the ventricle; 1, 1, the attachment of the extremities of the segments to the inner wall of the artery; 2, the middle of the attached segment; 3, the middle of the free border.

Figure 69.—A transverse section of the aorta immediately above the attachment of the semilunar valves; *d*, *e*, the coronary arteries given off at the sinuses or pockets behind the valves.

walls are about an eighth of an inch thick. Into it empty four veins coming from the lungs. In the floor of this ventricle is also an opening leading to the left ventricle, which is often called the *mitral* orifice from the valves which close it, the latter being named from a fancied resemblance they bear to a mitre.

The walls of the *left ventricle* are about twice as thick as those of the right ventricle, and at its base are generally above a half-inch in thickness.

Besides the opening just mentioned, is another leading to the aorta, or principal artery of the body. The mitral valve is supported by the columnæ carneæ, just as is the tricuspid valve. The heart is lined with a serous membrane, which makes up by its folds a large part of the valves.

Around the openings from the auricles to the ventricles are fibrous rings which serve as points of attachment for the muscular fibres. The fibres of the auricles are in two layers, the inner belonging to each auricle, the outer being a common coat and ex-

tending from one auricle to the other; some fibres are arranged as loops, others as rings. The fibres of the ventricles are more complicated, some common to both ventricles, some proper to one. Some are longitudinal, more run in a spiral direction downward, and to the left in front, and in an opposite direction behind. At the apex of the heart the fibres are twisted into a whorl-like arrangement. There are, in addition, certain deeply-set circular fibres.

The *pericardium* is a conical sac of serous membrane which encloses the heart and the beginning of the great vessels.

As this is the first time mention has been made of a serous membrane, a definition may be needed. The *serous membranes* properly include the arachnoid, the pleura, the pericardium, the peritoneum, and the tunica vaginalis testis. The structure of a serous membrane is a strong fibrous tissue upon which is placed a layer of pavement epithelial cells. This membrane is so doubled upon itself as to form a shut cavity, and the two epithelial surfaces are opposite to one another, and are bathed by the watery secretion of the membrane, so as to prevent friction of the organs about which they are placed. It should be noted that an organ covered by a serous membrane is not within the cavity of the membrane, but is enveloped much as anything may be held by a gloved hand, and entirely covered, but at the same time is upon the outside of the glove. In this manner the heart is covered by one wall of the pericardium, while the other lies against the walls of the chest, the pleura, etc., and its cavity contains liquid to prevent friction from the constant action of the heart.

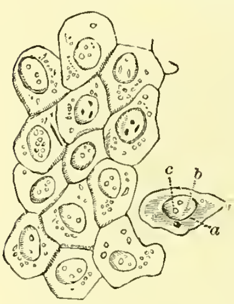


FIGURE 70. — Pavement epithelium from a serous membrane, magnified 400 diameters: *a*, substance of the cell; *b*, nucleus; *c*, nucleolus.

The Action of the Heart.

The action of the heart necessary to the circulation of the blood begins in the auricles. The auricles are gradually distended by a continuous stream of blood, on the right side from the vena cava, on the left from the pulmonary veins. When the auricles are full they contract. The orifices of the veins are not furnished with valves, so that in spite of the contraction of these orifices, probably some blood regurgitates, but the bulk of it is pressed forward through the auriculo-ventricular orifices into the ventricles. The ventricles immediately contract upon the blood thus poured into them, and its return to the auricles being barred by the closing of

the tricuspid and mitral valves, it must needs go into the pulmonary artery and the aorta, the valves of which open *into* these vessels. The ventricles relax to be again filled by the contraction of the auricles. By careful experiment it has been found that the time of a complete beat or "revolution" of the heart is divided thus: contraction of the auricles (auricular systole), two-tenths ; contraction of the ventricles (ventricular systole), four-tenths ; filling of the auricles (auricular diastole), four-tenths. The force of the heart is very considerable. The best experimental estimate of the contraction of the left ventricle makes its force equal to 51½ pounds.

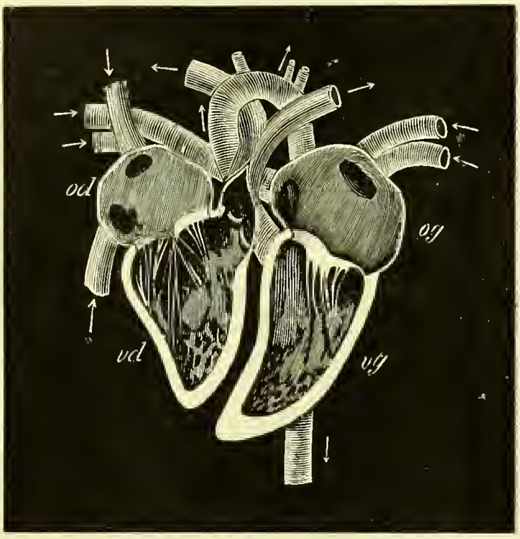


FIGURE 71.—Diagram of the four cavities of the heart: *od*, right auricle; *vd*, right ventricle; or *og*, left auricle; *vg*, left ventricle. The arrows show the direction of the blood-current.

At every contraction of the ventricles the heart raises itself somewhat, its point presses forward and moves slightly from left to right, and also twists from left to right, owing to the spinal course of some of the heart-fibres. Like any other muscle, the heart becomes harder during contraction and its length is diminished.

When the heart is listened to, two sounds are heard, which are called the first and second sounds of the heart. The heavy sound heard at the moment of the heart-beat is the *first* sound ; the sharp, clicking sound which immediately follows is the *second*. The first sound is caused by the closing of the mitral and tricuspid valves, by the contraction of the muscular substance of the heart, and by the impulse of the heart against the walls of the chest. The second sound is due to the closure of the aortic and pulmonary valves, after the contraction of the ventricles. The average rapidity of the heart's beat is about seventy pulsations to the minute in the male, seventy-five to eighty in the female ; but this is subject to considerable variation with age, etc., under various circumstances. In childhood the pulse is more rapid. Exercise, postures demanding exertion, such as standing, increase the rapidity of the heart's action.

The Course of the Blood in the Heart and Vessels

Is as follows: The right auricle is constantly filling up by the stream of dark venous blood returned from the system through the venæ cavæ. When the auricle is full it contracts as before mentioned, the blood passes into the right ventricle, and by the contraction of the latter is sent through the pulmonary artery to the lungs. Here, in the network of capillaries covering the air-cells, it absorbs oxygen and parts with carbonic acid and other sub-

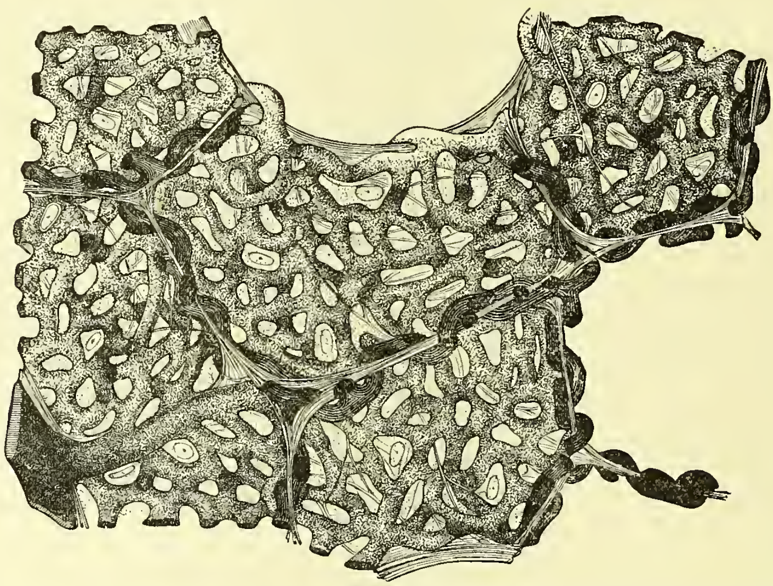


FIGURE 72.—Diagram of the capillary blood-vessels of the lung-tissue, forming a close meshwork about the air-cells; largely magnified.

stances to be mentioned farther on, and thus becomes arterial blood. From the pulmonary capillaries it is gathered by the pulmonary veins, and, passing forward to larger and larger trunks, is returned to the left auricle. The phenomena of the contraction of the auricle and ventricle are repeated and the red blood is distributed by the arteries throughout the system. In the systemic capillaries it undergoes an inverse change and becomes venous blood, and as such is returned to the right auricle to undergo the same round of changes again.

Let us follow the course of the blood in the vessels. When the blood is thrown into the great arteries, the recoil of these elastic vessels helps forward the current. It is a physical fact that an

elastic tube will deliver more liquid if received in an intermittent stream than would a non-elastic tube under precisely similar circumstances. The elasticity of the vessels is thus an advantage. The pulse is caused by the dilatation of the artery by a wave of blood, and by a certain locomotion of the artery itself. The rapidity of the current of the blood in the arteries varies with the situation of the vessel and action of the heart. Thus, in the metatarsal arteries the average was found to be rather more than two inches per second; in the carotid ten inches. In the carotid too, it varies from twenty inches per second when the ventricles are contracting, to six inches after the spring of the vessels has ceased.

In the capillaries the flow of the blood is in all directions, and, relatively to that in the smallest arteries, is slow. The vessels are pretty uniform in size, and of great aggregate capacity.

Since the capacity of the venous system is much greater than the arterial (variously estimated as from $2\frac{1}{4}$ to four times as great), the rapidity of the current is proportionally slow.

The chief cause of the flow of the blood in the veins is the pressure from behind of the blood in the capillary system; muscular action assists to some extent.

It is estimated that the time required for a given portion of the blood to make the entire round of the pulmonary and systemic circulations is about twenty-three seconds, and that the entire blood of the body passes through the heart in about fifty-eight pulsations, or in about forty-eight seconds.

The Constituents of the Blood.

The entire amount of blood is generally about one-eighth in weight of the whole body—a man of 160 pounds having say twenty pounds of blood. The blood found in the arteries is of a bright red color, that found in the veins is of a dark blue, or even blackish hue, except the blood coming from glands during their activity, which is red like arterial blood. The color of the blood is due to the corpuscles. There are in the blood two kinds of corpuscles, the red and the white. The red are very uniform in size, being about $\frac{1}{3500}$ of an inch in diameter, and about one-third as thick; their shape is that of circular discs flattened (see Fig. 74) and depressed in the centre on both sides. They are so numerous as to make up nearly one-half of the whole blood. They are more abundant in males than females. The white corpuscles, or leucocytes, are far fewer, their ratio to the red corpuscles being, soon after a meal, 1 to 400, or 500, a few hours after, 1 to 1,200, or 1,500. They are about $\frac{1}{2500}$ of an inch in diameter, spherical, with more or less granules in

their substance. These corpuscles are found also in lymph, chyle, semen, etc., and notably in pus.

The liquid in which the corpuscles float is called the plasma, or liquor sanguinis. Its chief constituent is water (about 78 per cent. in the male, 79 in the female), with about fifty substances, organic and inorganic, held in solution in it. The most important inorganic substance is common salt, three or four parts per thousand. These various substances are chiefly products of digestion, or of the waste of the tissues thrown into the blood.

FIGURE 73.—A, red corpuscles of human blood, magnified about 500 diameters: 1, shows depression on the surface; 2, a corpuscle seen edgewise; 3, red corpuscles altered by exposure.
B, pale corpuscles of human blood, magnified about 500 diameters: 1, natural appearance; 2, 3, corpuscles which have been acted on by acetic acid, so as to bring the nuclei better into view.

Blood has the peculiar quality of coagulation if it is drawn from the body or if its circulation is materially interfered with in any part. There is then formed a firm jelly-like mass, which presently contracts, squeezing out a watery liquid. This process

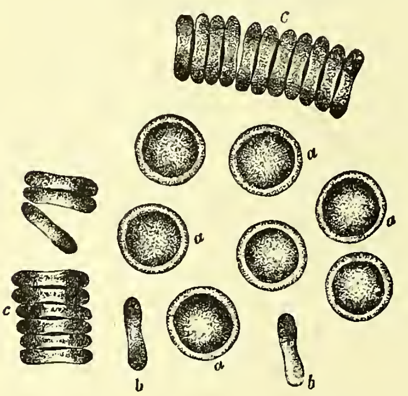


FIG. 74.

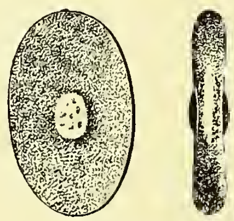


FIG. 75.

FIGURE 74.—Human blood-corpuscles, largely magnified: *a*, corpuscles as seen from the face; *b*, corpuscles standing edgewise; *c*, corpuscles arranged in groups like coins.
FIGURE 75.—An oval blood-corpuscle of the camel, as seen in different positions and showing a central enlargement or nucleus; very greatly magnified.

of contraction will probably be complete in ten or twelve hours. The solid part is called the coagulum or clot, and the liquid serum. This process is due to a constituent of the blood which has its power of spontaneous coagulation, called fibrin. This substance was formerly described as part of the blood in health, but more recently it has been considered as the result of the decomposition of certain other principles in the blood. Whatever its source, it is of

the greatest importance, as its property of coagulability is the means of arresting hemorrhage. The blood of some persons, said to have the hemorrhagic diathesis, or to be "bleeders," is destitute of this coagulating power, and to such persons any slight injuries, such as the drawing of a tooth, may prove serious.

The function of respiration is so intimately connected with the circulation of the blood, that a description of the Organs of Respiration may be properly introduced here.

THE RESPIRATORY APPARATUS

Is composed essentially of three organs, the larynx, trachea, and lungs. The larynx is likewise the organ of the voice. It is situated in the throat, its upper part forming the prominence commonly known as the Adam's Apple. It is a sort of box at the top of the wind-pipe, composed of cartilages, and contains the organ of the voice. It will be more fully described in the Chapter on the Throat and Neck.

The thyroid cartilage is formed of two rather square-shaped plates, united in front, just under the skin, in a vertical wedge-shaped ridge, and diverging behind, where they embrace the body of the cricoid cartilage. The cricoid is shaped like a seal ring, the seal being posterior; it is separated a little from the thyroid in front, being hung below it by a membrane, and closely jointed to it behind by ligaments; its lower surface is connected with the trachea; its upper surface in front with the thyroid, behind jointed to, and surmounted by, the arytenoid cartilages.

The arytenoid cartilages are two in number, triangular pyramids in shape, with one angle of each base projecting forwards towards the junction of the thyroids in front.

These anterior angles of the arytenoids have each the posterior end of a vocal cord, composed of yellow elastic tissue attached to them; its anterior extremity being attached to the thyroid cartilage at about the middle of its junction with its fellow thyroid. The rotation of the arytenoid cartilages on their bases, where they rest on the top of the cricoid, causes the vocal cords at their posterior ends to move towards or from each other. The sliding backwards of the arytenoids stretches, and the sliding forwards relaxes the vocal cords.

A pair of muscles, one for each cord, presides over each of these motions. The two vocal cords are attached in front to nearly the same point on the thyroid, and are separated behind to the extent of about half an inch when dilated, and are in contact throughout

their whole length when their posterior attachments (anterior angles of the arytenoids) are swung together.

The space formed by the separation of the vocal cords is known as the glottis. This space is widely open during inspiration, and partly closed during expiration. Above, and parallel to the true, or lower vocal cords, are folds of mucous membrane, known as the false vocal cords.

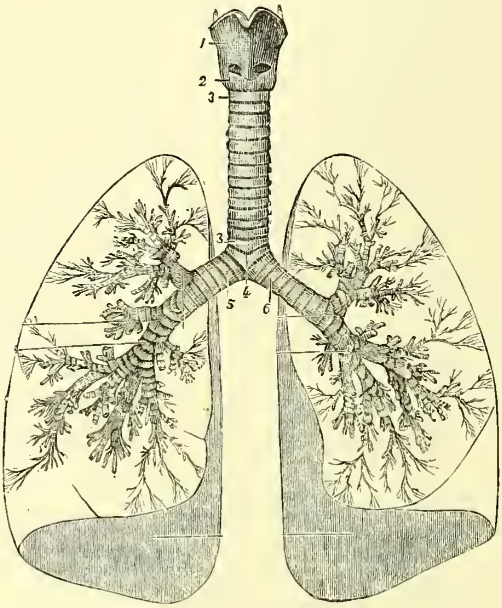


FIGURE 76.—Diagram of the larynx, trachea, bronchial tubes, and outline of the lungs: 1, thyroid cartilage; 2, cricoid cartilage; 3, first cartilage of the trachea; 4, bifurcation of the trachea; 5, 6, bronchial tubes.

The epiglottis is a leaf-like cartilage attached by its stem near the upper anterior edge of the thyroid cartilage; its office is to cover the glottis during the act of swallowing when the whole larynx is drawn upwards to the base of the tongue, and so prevent foreign bodies from entering the glottis.

The larynx is lined throughout by mucous membrane, which is continuous with that in the pharynx above, and the trachea below.

Its blood is supplied through the inferior and superior thyroid arteries, and its nerves are called inferior and superior laryngeal.

The Trachea

Is a tube about five inches long, composed of rings of cartilage united by membrane, lined with mucous membrane, extending from the larynx to a point a little below the top of the breastbone, where it divides into two tubes, known as the primary bronchi. One bronchial tube goes to the right, and the other to the left lung. (Fig. 76.) These divide and redivide until their branches form a tree.

The Lungs

Are the most essential organs of the whole respiratory apparatus. They are two in number—situated one on either side within the cavity of the thorax, with the heart lying between them in front.

The cavity of the thorax has for its walls on the sides and in front the ribs, and behind the ribs and backbone ; these are lined

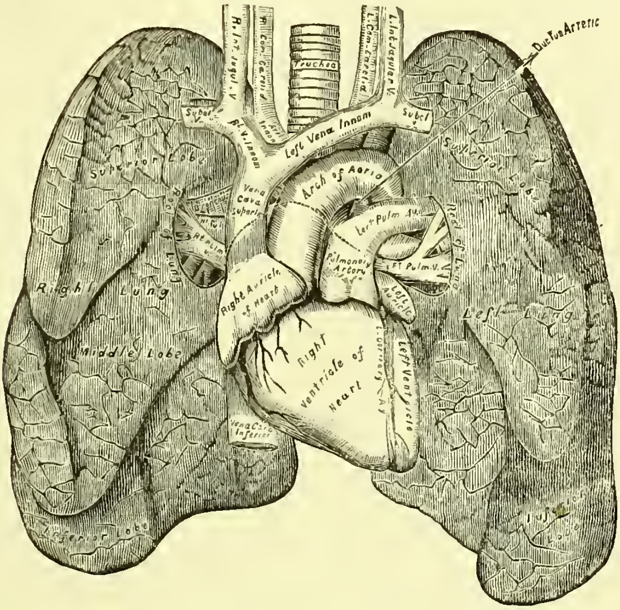


FIGURE 77.—The heart, large vessels, and lungs ; the front margins of the lungs have been turned outward so as to show the relations of the organs.

by muscles and a serous membrane called the pleura. Its floor is formed by a strong arched muscle, called the diaphragm, which is attached all around the borders of the lower true ribs and to the backbone. Its roof is conical in shape, and is formed by the muscles of the root of the neck, and extends an inch or two above the upper rib. The whole thoracic cavity, except the space occupied by the heart, great vessels, and œsophagus, is occupied by the lungs. Should the diaphragm descend, the cavity of the thorax would be increased in size, and air would be sucked into the lungs through the larynx and trachea to fill the vacuum thus formed. The raising of the ribs increased the thoracic cavity with the same result. In ordinary respiration both these movements are combined.

Between the walls of the chest and the lungs lies a serous membrane (see page 8) called the pleura. One of its layers covers the walls of the chest, and the other the lung. The lungs are divided

into lobes, and these into lobules. Each lung is divided by a deep fissure into an upper and lower lobe, and on the right side the upper lobe is divided by a shallower fissure, the part below it being called the middle lobe.

To understand the manner in which the lungs perform their function requires some explanation of their minute structure. The description of a single lobule will suffice to explain the whole, as their aggregation forms the lungs. The lobule has leading into it a small bronchial tube $\frac{1}{120}$ to $\frac{1}{75}$ of an inch in diameter, which breaks

Fig. 78.

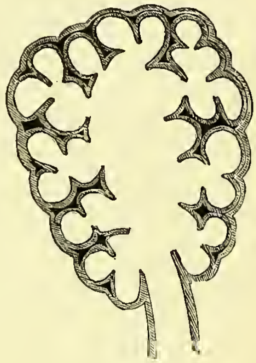


Fig. 79.

Figure 78.—Diagram of two small lobules of a lung, from its surface: *a*, the outer margins of the two lobules; *b*, air-cells; *c*, the smallest bronchial tubes.

Figure 79.—Diagram of the section through a lobule of lung.

up into branches, each one ending in an elongated cell terminating with a rounded extremity, called an air-cell. The walls of the cells are largely made up of capillary blood-vessels, the finest and most abundant network of the kind in the body. This thin membrane when moist is admirably calculated for the process of osmosis, the oxygen and other gases passing readily through it.

Respiration

May be defined as the process by which the system receives oxygen and is relieved of carbonic acid. Its essential conditions in the human subject are air and blood, separated by a membrane which will allow the passage of gases. Inspiration is effected by descent of the diaphragm and elevation of the ribs, and expiration by the ascent of the diaphragm and descent of the ribs. Respirations vary in frequency from forty-four per minute at birth to eighteen per minute at the age of thirty to fifty years. Sleep diminishes and exertion increases their frequency. The residual

air, *i.e.*, that which cannot be expelled by forced expiration, is about 100 cubic inches. The *reserve air*, *i.e.*, that which remains after ordinary expiration, deducting the residual air, is also about 100 cubic inches. The ordinary *tidal air* is about 20 cubic inches, but may become temporarily increased to four times as much. The *complemental*, *i.e.*, the excess during forcible inspiration over ordinary breathing air, is about 110 cubic inches. The average *expiratory* capacity of a man five feet eight inches high is 230 cubic inches. The fresh air is not sucked into the lungs below the larger bronchial tubes, but finds its way by the physical law of diffusion of gases. Pure air consists of about twenty-one parts oxygen to seventy-nine of nitrogen, the latter seeming to act simply to dilute the oxygen. The air loses about one-fifth of its oxygen, and gains nearly the same quantity of carbonic acid gas in its passage into and out of the lungs ; there is some water, ammonia, organic matter, etc., also added to the air from the lungs. The carbonic acid expired comes from the venous blood, being the result of those tissue-changes which we call life. In the capillaries surrounding the air-cells, the carbonic acid is lost by the blood and passes through the walls of the capillaries and of the air-cells, and at the same time the blood-corpuscles take up their load of oxygen from the air in the air-cells and return with it to the left side of the heart. The loss of a large portion of blood, by depriving the tissues of the body of the constantly needed oxygen, causes a sense of want of air. (See also Section on Air)

THE LYMPHATIC SYSTEM.

Throughout the body is found a system of vessels known as the *absorbents*. The vessels are quite small, the main trunks being rarely a twelfth of an inch in diameter. Their origin is, so far as is known, in a net-work of very fine vessels not connected with those carrying blood. These lymphatics communicate more or less with each other, and are furnished with valves at short intervals, so that, when filled, they have a beaded appearance. The course of the vessels is interrupted in certain places by bodies known as lymphatic glands. These are more abundant in some parts of the body than in others. They are most evident, especially when inflamed, in the neck, the arm-pit, and the groin. The largest lymphatic vessel has a diameter about equal to that of a goose-quill and is called the *thoracic duct*. It begins opposite the second lumbar vertebra in a sort of pouch into which the chyle is brought by the lacteals, and ascends to the level of the collar-bone, where it empties into the left subclavian vein. It conveys the

lymph from the entire body except that from the right side of the head, neck, and chest and its organs, and a part of the liver. The lymphatics carry a thin and nearly colorless liquid called the lymph. This liquid is doubtless derived from the blood, but its uses are little understood. One group of lymphatics, the lacteals, will be particularly spoken of in connection with digestion.

THE NERVOUS SYSTEM

Consists of a collection of organs through which our impressions are received, and by means of which the action of all other organs is controlled. Anatomically, there are two grand divisions.

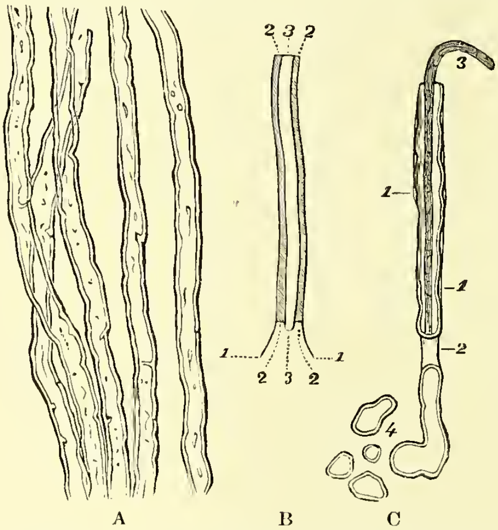


FIGURE 80.—A, white or tubular nerve-fibres, showing the sinuous outline and double contour of the medullary sheath: B, 1, 1, membranous tube; 2, 2, white substance or medullary sheath; 3, axis or primitive band. C, diagram representing the occasional appearance of a ruptured tubular nerve-fibre: 1, 1, membrane of tube seen at parts where the white substance has separated from it; 2, a part where the white substance is interrupted; 3, axis, projecting beyond the tube; 4, part of contents of the tube escaped. (Largely magnified.)

1. *The cerebro-spinal system*, including the brain and spinal cord and the nerves directly arising from them. This system presides over sensation, voluntary motion, intellection, and all the functions generally described as belonging to animal life.

2. *The sympathetic system*, composed of ganglia in various parts of the body and nerves arising from them. This system presides over nutrition or the functions of vegetative life.

The nerve-tissue is divided into the nerve-cells, which generate what is called nerve-force, and the nerve-fibres which conduct that force.

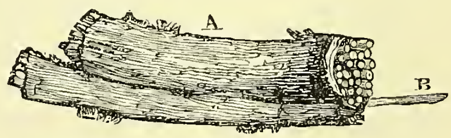


FIGURE 81.—Portion of the trunk of a nerve, consisting of many smaller cords wrapped in a common sheath: A, the nerve; B, a single bundle of nerve-fibres drawn out from the rest.

The tubular nerve-fibre has a sheath, its medullary contents and an axial band in the centre, but one or more of the elements may be wanting. The size of these fibres varies in diameter from $\frac{1}{25000}$ to $\frac{1}{1250}$ of an inch. Another variety of

fibre is found abundantly in the sympathetic system. Nerve-fibres do not branch as do blood-vessels ; each fibre is continuous, and the

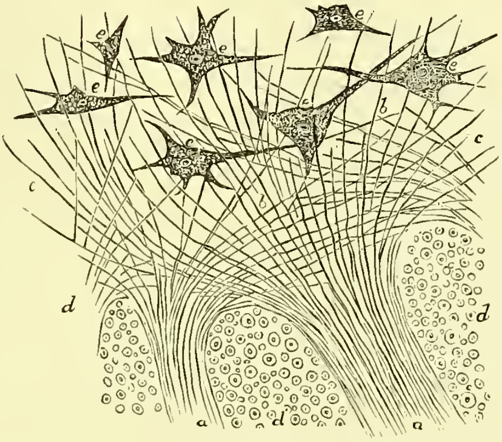


FIGURE 82.—Small portion of a transverse section of the spinal cord at the place where two bundles of fibres of the anterior roots pass into the gray substance of the cord: *a*, *a*, the two bundles of fibres of the anterior roots; *b*, *b*, these fibres running backward through the gray substance; *e*, *e*, large radiated nucleated nerve-cells.

branching of a nerve is simply the splitting up of its fibres, as one might unravel the threads of a cord. The mode of termination of the nerve-fibres is quite various. In the voluntary muscles it is generally by a plate-like enlargement of the axial band. In

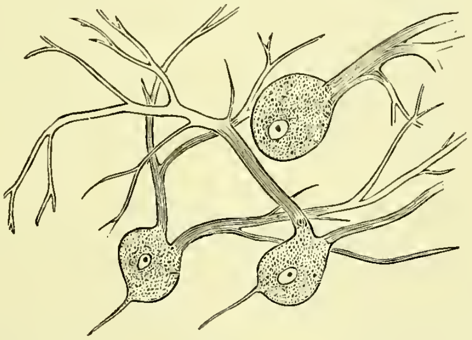


FIGURE 83.—Nerve-cells from the cortical gray matter of the cerebellum; magnified 260 diameters.

many parts of the body, notably in the palms and the soles, many fibres end in little olive-like bodies, called Pacinian corpuscles. Very similar to these last are the "tactile corpuscles," supposed to be peculiarly related to the sense of touch. Still other forms of termination have been described.

The nerve-centres contain a large quantity of a gray matter which is made up of cells, each with a nucleus and nucleolus, and

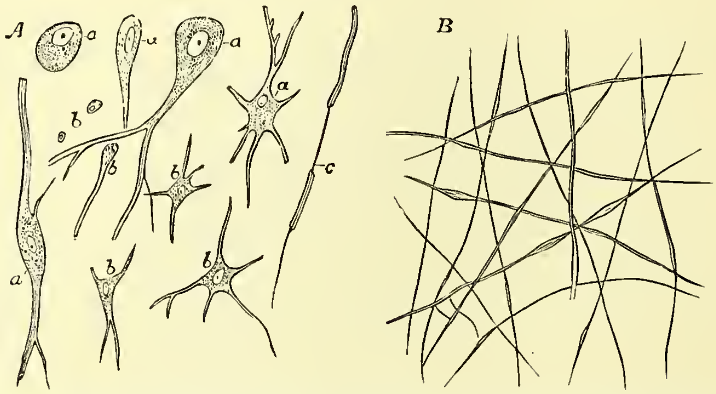


FIGURE 84.—Minute structure of the substance of the cerebrum, magnified 220 diameters: A, *a*, *b*, nerve-cells with radiating processes; *c*, nerve-fibre with its axis cylinder partly uncovered. B, fine nerve-fibres from the surface of the convolutions of the brain.

a granular substance between them. The nerve-cells are gener-

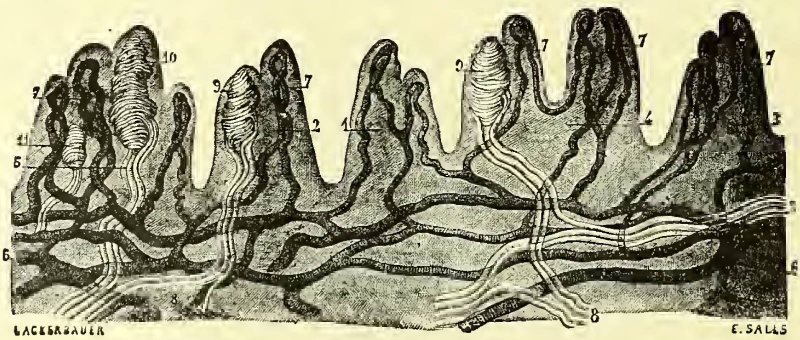


FIGURE 85.—Section of the deep layer of skin, showing its papillæ, into which loops capillaries and nerve-fibres extend: 1, small venous twig receiving branches from the capillary vessels; 2, nerve-fibres; 3, 4, papillæ of the true skin or corium [See Chapter on the Skin and Hair]; 5, bundle of nerve-fibres going to a touch-corpuscle; 6, small artery giving off capillary branches; 7, 7, 7, 8, 9, 10, 11, "tactile" corpuscles, in which the sense of touch is most acute.

ally provided with fibre-like prolongations, two, three, and sometimes as many as ten or twelve.

Spinal Cord.

The *spinal cord* occupies the canal of the spinal column. It is enveloped by three membranes: the outer, strong and fibrous, is called the *dura mater;* the middle one is a delicate serous mem-

brane called the *arachnoid;* the inner, called the *pia mater*, is but a gauzy net-work of fibres sufficient to support the blood-vessels going to the cord. The cord itself is about sixteen inches long. It does not completely fill the canal of the column, which contains, besides the cord and its membranes, a certain amount of liquid. The cord breaks up opposite the first lumbar vertebra into a bundle of nerves called the horse-tail (*cauda equina*).

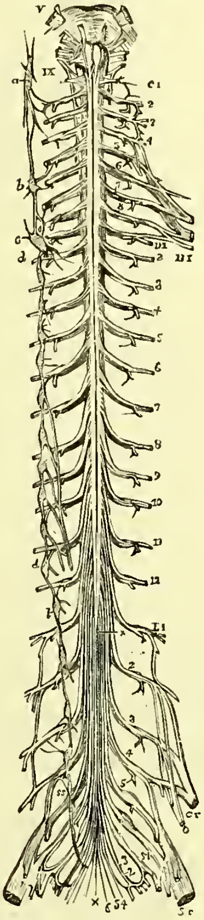


FIGURE 86.—Diagram of the spinal cord and first portion of the spinal nerves, together with the chain of sympathetic ganglia on the right side, and their connections.

C1, first cervical nerve; 2 to 8, the other cervical nerves; D1 to 12, the dorsal nerves; L1 to 5, the lumbar nerves joining to form the anterior crural (*Cr.*) and obturator (*o*) nerves. Below this are the sacral nerves, forming the great sciatic (*Sc*) or large nerve of the thigh.

Above, *Br* indicates the brachial plexus.

On the right side (left of the figure) the letters indicate the ganglionic masses of gray matter belonging to the sympathetic system and which are connected with the roots of the spinal nerves.

In the neck, and at the bottom of the dorsal vertebræ, the cord is enlarged, and from these enlargements are given off the nerves for the upper and lower extremities. The cord, as a whole, has, roughly speaking, the shape of a fluted cylinder. The cut on page 78 shows the various columns and fissures, and distribution of gray and white matter, the gray matter being a sort of H-shaped column within the cylinder of the white matter. The white matter is composed of nerve-fibres, connective tissue, and blood-vessels; the gray, of cells and fine fibres.

The action of the cord as a conductor is briefly this: the front and side white columns (see Fig. 87) carry stimulus from the brain to the muscles. Their fibres cross from one side to the other in the medulla, hence a disease of one side of the brain causes paralysis, if at all, upon the opposite side. The gray substance of the cord carries sensory impressions to the brain. The back white columns assist in co-ordinating muscular movements. Besides its office as a conductor, the spinal cord has a function as a producer of reflex movements—that is, such as are produced unconsciously. Very many things that we do in sleep are probably reflex. A common and striking example of such reflex action is the run-

ning, etc., of fowls after the cutting off of their heads. Of course, the head having been removed, such action cannot be conscious or voluntary or in any way dependent upon the brain.

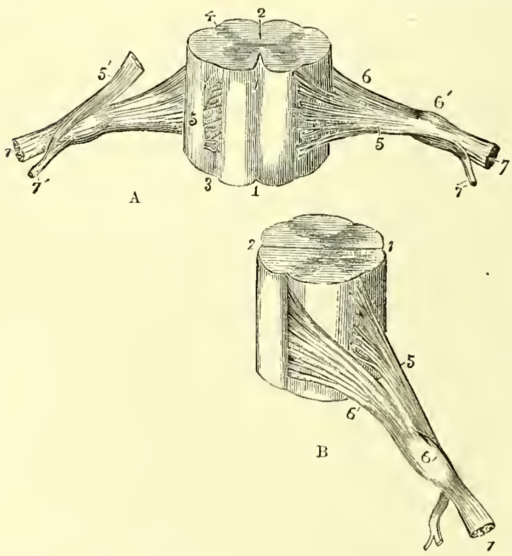


FIGURE 87.—Section of the spinal cord at the cervical region, with the roots of the spinal nerves: A, a front view, the anterior root of the right side being divided. B, view of right side: 1, anterior median fissure; 2, posterior median fissure; 3, 4, depressions where the roots of the nerves make their exit; 5, anterior roots passing the ganglion; 6, posterior root passing into the ganglion of gray matter; 7, the united or compound nerve; 7′, posterior primary branch, having fibres from each root.

Opposite each opening between two vertebræ is given off, on each side of the cord, a spinal nerve. It arises from two roots: anterior and posterior, the latter having upon it an enlargement called a ganglion. As might be imagined, from the account given of the conduction of the cord, the anterior roots convey only motor stimuli, and the posterior only sensory impressions. The two roots presently unite to form a nerve, which is now a mixed nerve, *i. e.*, both motor and sensory, and all the branches of such nerves preserve this mixed character. Through these nerves we are able to move at will any part of the body furnished with voluntary muscles, but we find it difficult to execute some motions without including certain others not intended: these are called associated motions. Thus, the last three fingers are apt to all move together, yet they can be moved singly; again, it is difficult to use the two hands in dissimilar manners (as, for instance, in the child's feat of rubbing the head with a circular motion of one hand, and patting the abdomen with the other), keen concentration of attention being required to prevent the second hand imitating the motions of the first. So, too, there are associated sensations which will occur to every one.

The nerve-force, which has been frequently mentioned, is not identical with any other known force. It is not electricity. It is transmitted along the nerve-fibres at a definite rate, which varies under certain circumstances, but which is relatively to the "imponderable" forces quite a slow one. This rate, both in motor and sensory fibres, is about one hundred and eleven feet per second.

The Brain

Is protected by three membranes having the same names as those of the spinal cord. The outer one, the dura mater, is strong and fibrous, and clings to the inner surface of the skull. It also sends down strong prolongations between the hemispheres, and between the cerebrum and cerebellum. The arachnoid is a serous membrane, and the inner, the pia mater, is a light connective tissue largely filled with blood-vessels.

The brain is divided into four principal parts: the *cerebrum*, or the hemispheres; the *cerebellum*, or the little brain; the *pons Varolii* (bridge of Varolius), and the *medulla oblongata*, or oblong marrow.

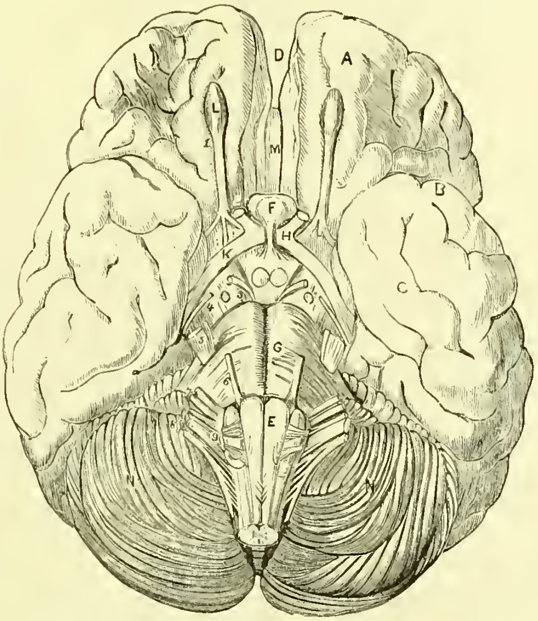


FIGURE 88.—Base of the brain: A, anterior lobe of the cerebrum; B, fissure of Sylvius separating it from the middle lobe (C); D, the longitudinal fissure; E, medulla oblongata; F, pituitary body; G, pons Varolii; H, the optic commissure; K, the optic tract; L, bulb of the olfactory nerve; M, corpus callosum; N, N, under surface of the cerebellum; O, O, crura cerebri. The numbers indicate the roots of the nine pairs of cranial nerves.

The entire brain weighs on an average 49½ ounces for males, and 44 ounces for females. The largest male brain recorded weighed 65 ounces; the largest female brain 56 ounces. The size of the brain bears some general relation to the intellectual power of the person, but this rule is subject to constant exceptions.

The *hemispheres* make up the greater portion of the brain, and are divided by a deep cleft running from before backward. The upper surface is rounded, following the contour of the skull; the base is irregularly flattened, and the surfaces divided by the fissure are flat. The surfaces, moreover, are irregular by reason of the convolutions. The surface of the convolutions is composed of gray matter, and the interior of white nervous substance. The folding in of the convolutions very much increases the amount of gray matter. The depth and size of the convolutions bear a gen-

eral relation to the intellectual power and activity of the individual. The hemispheres are neither sensitive nor irritable ; that is, irritation of them excites neither pain nor muscular movements. Within them, however, some motor centres have been distinguished. The brain is the organ of the mind. If it is removed from an animal a condition of intense stupor results. In idiots the brain is exceedingly small. Recent observations of disease of the brain, accompanied by loss of speech, have led to the considering of the third frontal convolution on the left side as the probable seat of the faculty of speech. Beyond this the location of given mental faculties, as is pretended by phrenologists, in given parts of the brain, has no physiological foundation whatever.

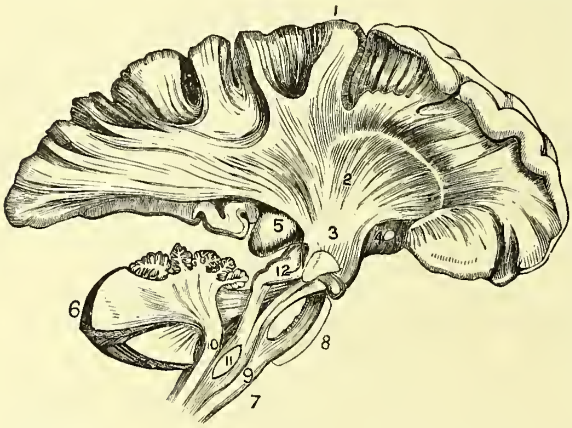


FIGURE 89.—The columns of the medulla oblongata and their connection with the cerebellum and cerebrum : 1, cerebrum ; 2, fibres of the medulla oblongata radiating to the outer surface of the cerebrum; 3, crus cerebri; 4, striated body; 5, optic thalamus; 6, cerebellum ; 8, pons Varolii; 9, anterior pyramid; 10, restiform body; 11, olivary body; 12, corpus quadrigemina.

The *cerebellum*, or little brain, lies beneath the posterior part of the brain. Its weight is about one-eighth of that of the hemispheres. It is composed of gray and white matter, the gray external. Instead of convolutions this surface is marked by furrows lying closely together, and following a curved direction. The cerebellum is also divided into two hemispheres. It is not sensitive and is not irritable. Its function, so far as we know, is to co-ordinate and regulate muscular movements. It has been thought, too, to have some relation with the generative instinct ; but this is not established.

The *pons Varolii* (or tuber annulare) connects the hemispheres above with the cerebellum behind and the medulla below. The functions of the pons, so far as they are yet made out, are the originating of the stimulus of some voluntary movements, independently of the hemispheres, and probably it likewise regulates the automatic voluntary movements of standing, walking, etc. The tuber annulare, moreover, recognizes impressions of pain even after the removal of the cerebrum. Such impressions are ordinarily transmitted to the hemispheres and then remembered. Every

surgeon is familiar with violent expressions of pain from patients under the influence of an anæsthetic who yet have no recollection of the pain when the anæsthesia has passed away. It is thought that such manifestations are due to the action of the ganglion of the pons.

Just below the pons, and at the top of the spinal cord, lies the *medulla oblongata.* In the medulla are a number of collections of gray matter. Those in the lateral tracts have the exceedingly important function of presiding over the respiratory sense. If these be broken up, as is sometimes done in physiological experiments,

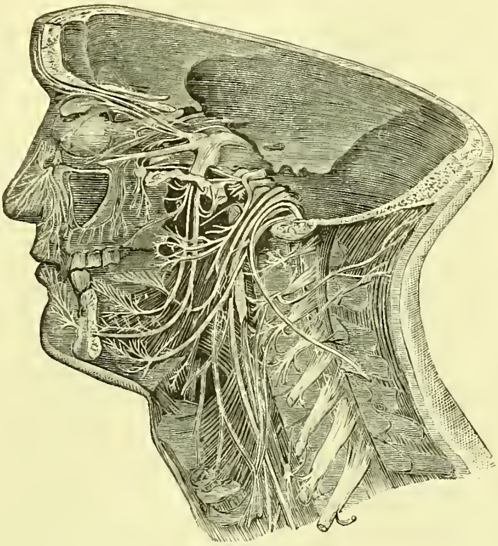


FIGURE 90.—Diagram of the cranial nerves on the left side.

with an instrument similar to a brad-awl, the animal instantly ceases to breathe. He dies—not from asphyxia, as he would if deprived of air by tying his windpipe, but simply because he no longer recognizes the need of air, and makes no effort to gain it.

[It is the injury of this part that is aimed at in executions by hanging, the mechanism by which it is brought about having already been described in the Section relating to the Bones of the Vertebral Column.]

There are in the brain certain other centres, the functions of which are in some degree known. Thus, the *corpora striata* have a crossed action upon muscular movement—that is, the centre on one side acts upon the opposite side of the body. The *optic thalami* perform a similar office. The *tubercula quadrigemina,* sometimes called the *optic lobes,* preside over the sense of sight. Their

action is likewise crossed. The general course of the fibres from the tubercles to the eyes is crossed, but some fibres go to the same side, a few connect the two tubercles, and a few the two eyes.

Nerves of the Head.

The nerves that pass out of the cavity of the cranium are called the *cranial nerves.* They are classified according to the position of their exit from the skull, counting from before backward. There

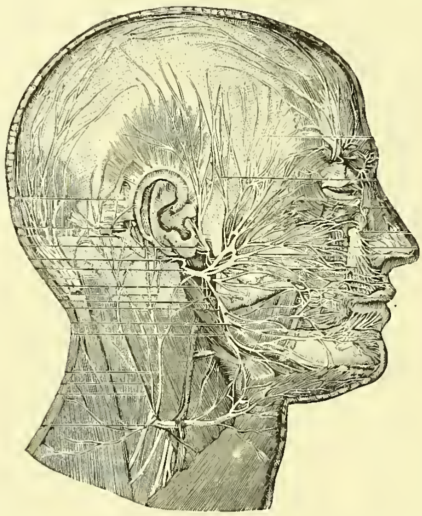


FIGURE 91.—Distribution of the seventh cranial nerve on the right side of the face, head and neck.

are, thus counted, nine pairs, a pair being made up of the nerves on the two sides of the head. They are :

First pair.—Olfactory, special nerve of smell.

Second pair.—Optic, special nerve of sight.

Third pair.—The common nerve of the eye which supplies all the muscles of the eye, except two.

Fourth pair.—The pathetic nerve going to the superior oblique muscles of the eyes.

Fifth pair.—A small motor root going to muscles of mastication, and a large sensitive root—the general nerve of sensibility of the face.

Sixth pair.—External nerves of the eye. They turn the eyes outward.

Seventh pair.—The "soft part" is the special nerve of hearing ;

the "hard part" (the facial), is the motor nerve of the superficial muscles of the face—the nerve of expression therefore.

Eighth pair.—Three mixed nerves, the glosso-pharyngeal, the pneumogastric or par vagum, and the spinal accessory. The

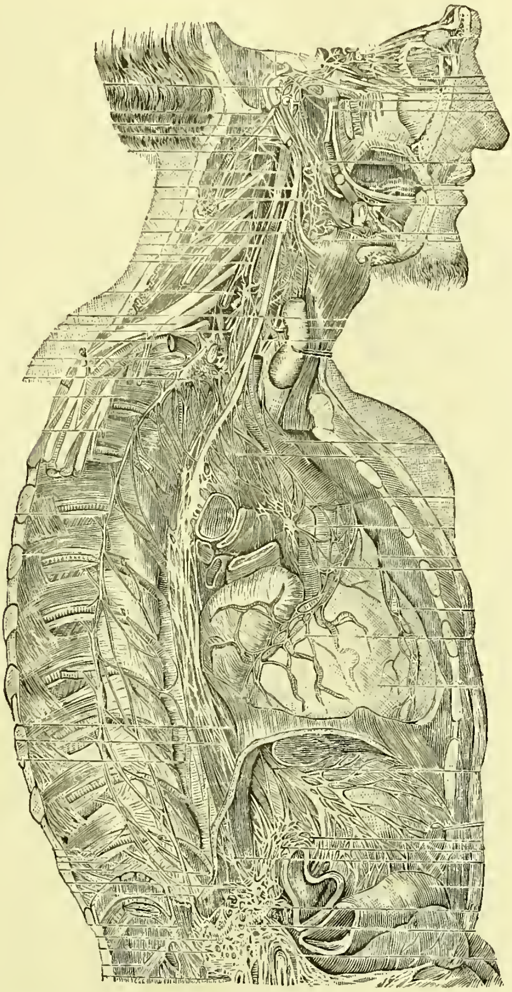


FIGURE 92.—The pneumogastric nerve and its branches.

glosso-pharyngeal and a small branch from the facial form the nerve of taste.

The pneumogastric is very widely distributed, and is concerned in the acts of swallowing. It controls the movement of the larynx in breathing, acts as a regulator of the motions of the heart

and the respiratory movements, and controls the motion of the stomach in digestion.

The *ninth pair* is the sublingual, a motor nerve of the tongue.

The Spinal Nerves.

The origin of the spinal nerves has been already spoken of. [See Fig. 87.]

The anterior roots of the upper four nerves of the neck are connected to form the cervical plexus. The branches of this plexus are quite numerous, the most important of which is probably the phrenic nerve, which is the motor nerve of the diaphragm, and is hence the chief nerve of respiration. The anterior branches of the fifth, sixth, and seventh nerves of the neck unite, those of the eighth cervical and first dorsal unite. The two large nerves thus formed throw off fibres to unite and form a third cord called the posterior. This arrangement of nerves is called the brachial plexus. In the middle of the arm-pit the three cords lie to the inner and outer sides of and behind the axillary artery, and at the lower part of the arm-pit they break up into the nerves of the upper extremity. The three largest branches are the ulnar, the median and the musculo-spiral. The ulnar (from the inner cord) passes down the inner side of the arm, just inside the "funny bone," and so downward, and ultimately supplies the little finger and adjoining surface of the ring-finger.

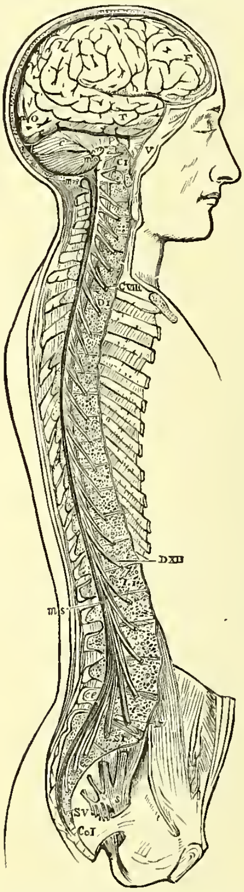


FIGURE 93.—Diagram of the brain and spinal nerves, as seen from the right side.

The median, arising by branches from the inner and outer cords, accompanies the brachial artery to the elbow, thence down the middle of the forearm, and supplies the thumb and those fingers not supplied by the ulnar.

The musculo-spiral supplies the back of the arm and forearm. All of these nerves supply both muscles and skin.

In the dorsal region are given off on each side twelve dorsal nerves. The posterior branches supply the muscles and integument of the back. The anterior branches run between the ribs and are called the intercostal nerves.

In the lumbar region are given off five nerves, their posterior branches, like the preceding nerves. going to the back. The anterior branches unite to form a plexus, which sends branches to

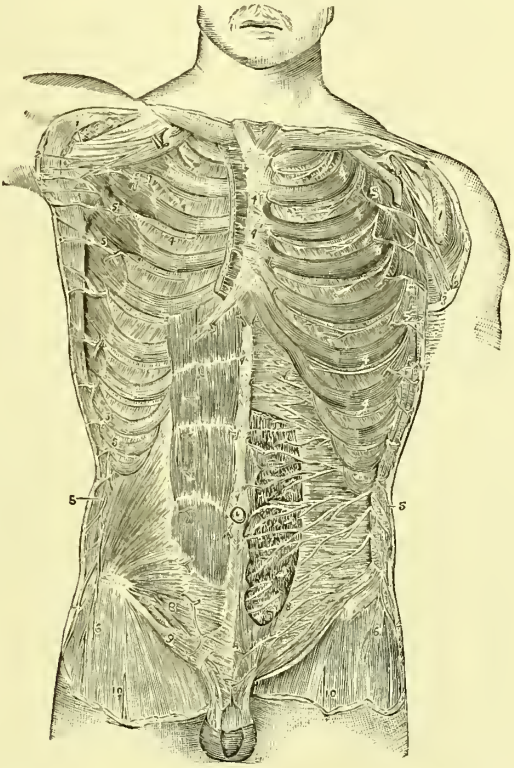


FIGURE 94.—Anterior view of the distribution of some of the dorsal nerves: 1, the median and other nerves of the brachial plexus; 2, 3, nerves going to the arm; 4, intercostal nerves; 5, branches going to the skin.

the walls of the abdomen, to the genitals, and to the lower extremity. By far the largest branch is the anterior crural nerve, which passes into the thigh a little to the outer side of the femoral artery. It supplies the front and inner side of the thigh, leg, and foot.

There are five sacral nerves, a part of which go to form the sacral plexus. The most important branch of this plexus is the great sciatic nerve, which escapes from the pelvis just to the outside of the seat-bone, and runs down the middle of the back of the thigh and leg, and is finally distributed to the sole of the foot. Just above the knee the sciatic divides, sending a branch called the peroneal to the outer side of the leg. The other branch, practically a continuation of the main trunk, is called the internal pop-

liteal nerve, which below the popliteus muscle again changes its name to the posterior tibial nerve. Its branches in the sole are the internal and external plantar nerves.

Besides the nerves and centres included in the cerebro-spinal system, there is another system throughout the body, called

The Sympathetic System.

This is made up of ganglia and fibres, the latter being, to speak in a general way, distributed to the mucous membranes, to the unstriped muscles, and to the vessels. The ganglia of this system are

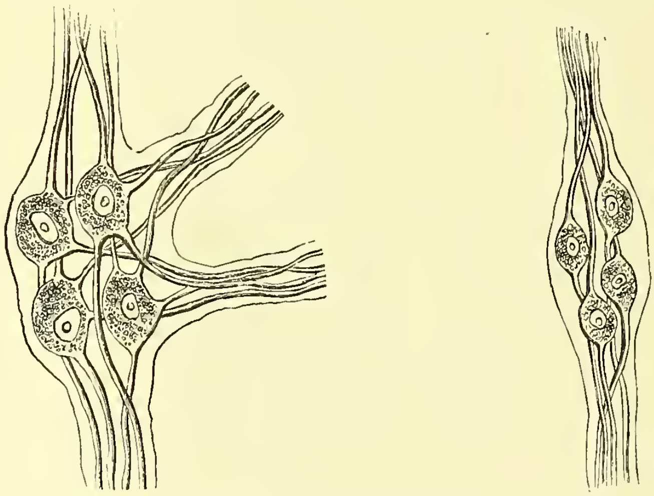


FIGURE 95.—Nerve-cells and fibres forming a ganglion.

found in the head, neck, chest, and abdomen. They are arranged in pairs, except at the extremity of the spinal column, where there is but one. These ganglia are connected by fibres to each other, and to nerves of the cerebro-spinal system. Besides they send off fibres which make intricate plexuses about blood-vessels, viscera, etc. Owing to the intermingling of sympathetic and cerebro-spinal fibres in very many nerves. the problem of determining the exact functions of such nerves becomes more difficult. The cardiac plexus is such an instance. Behind the stomach lies the solar plexus, which is composed of the two semilunar ganglia with nerves. This plexus is so important as to have been sometimes called the "abdominal brain." It gives rise to a large number of other plexuses. The functions of the sympathetic system are after all but

little understood. It seems to preside over such actions as proceed slowly, involuntarily, and in some way to modify or control the processes of nutrition.

Further details regarding the nervous system will be given in the articles upon the diseases of its different parts.

The anatomy of the organs of the special senses will be considered in the articles upon the diseases of those organs.

THE DIGESTIVE APPARATUS

Consists of an alimentary canal and various accessory organs. The alimentary canal is a muscular tube lined with mucous membrane, extending from the mouth to the anus. Its length is about thirty feet, and its different parts bear different names, viz.: the mouth, the pharynx, the œsophagus or gullet, the stomach, and the small and large intestines. The accessory organs are the teeth, salivary glands, the liver, and pancreas.

Mouth.

The *mouth* has an oval-shaped cavity when open, and has very little cavity when closed. Above it is bounded by the palate, which separates it from the nasal cavity. Its sides are formed by the cheeks, and behind its boundary is the soft palate. Its lining contains many mucous glands, and in health its whole surface is quite moist. The mouth becomes continuous with the next division, the pharynx, when the soft palate is raised, and the epiglottis depressed as in swallowing.

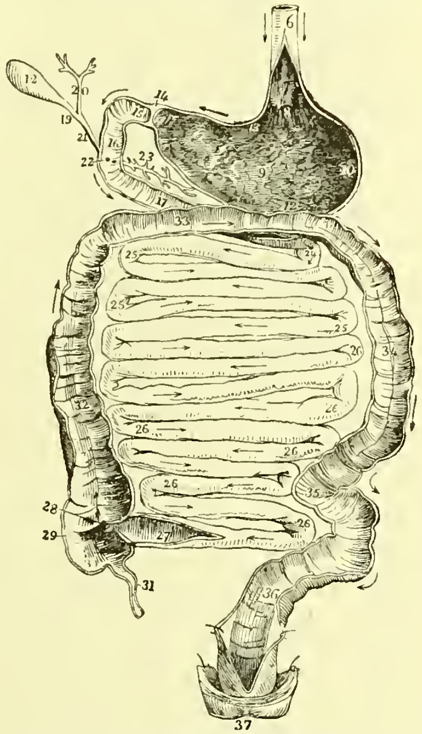


FIGURE 96.—Diagram of the digestive apparatus: 6, œsophagus; 9, stomach; 10, cardiac extremity; 11, pyloric extremity of the stomach; 12, gall-bladder; 14, pyloric muscle; 15, 16, 17, duodenum; 19, duct of the gall-bladder; 20, duct of the liver; 21, common duct through which the bile enters the intestine; 22, orifice of the common duct; 23, duct of the pancreas; 25, jejunum; 26, ileum; 27, lower end of small intestine; 28, ilio-cæcal valve; 29, cæcum; 30, pouch of the cæcum; 31, worm-like appendix; 32, ascending colon; 33, transverse colon; 34, descending colon; 35, sigmoid flexure or S-shaped flexure of the colon; 36, rectum; 37, anus.

In the mouth, the food is mechanically divided by the teeth

(see Chapter on the Mouth) and mixed with the saliva by the motion of the jaw and tongue. The saliva comes from a considerable number of glands, but those ordinarily called the salivary glands are the parotid, submaxillary, and the sublingual. The *parotid* is the largest. It is situated below and in front of the ear; its duct, called Steno's duct, empties into the mouth opposite the second molar of the upper jaw. Its secretion is thin and is more abundant during the act of chewing and also when some sapid substance is in the mouth. Its office is largely to mechanically reduce the food to a proper consistency for swallowing. The *submaxillary* gland lies beneath the jaw and secretes a thick liquid most abundant when sapid substances are present. The *sublingual* gland lies beneath the tongue, and its secretion is yet more viscid than the last. It is estimated that the entire amount of saliva secreted daily is nearly three avoirdupois pounds. The presence in the mouth of an irritant, as, for instance, tobacco, may greatly increase this amount. (See, also, Chapter on the Mouth.)

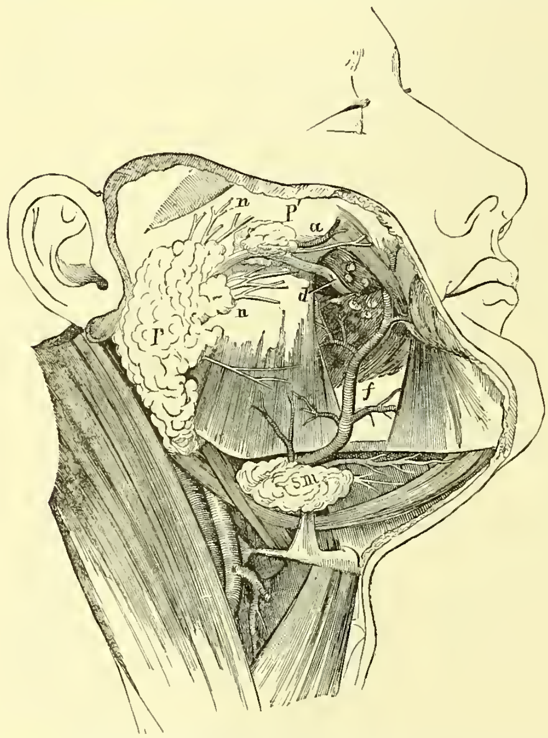


FIGURE 97.—Diagram showing the position and size of the parotid and submaxillary glands (two-fifths the natural size): *p*, the larger part of the parotid gland; *p'*, the small part which lies alongside the duct on the masseter muscle; *d*, the duct of Steno before it perforates the buccinator muscle; *a*, transverse facial artery; *n*, *n*, branches of the facial nerve emerging from below the gland; *f*, the facial artery passing out of a groove in the submaxillary gland and ascending on the face; *s*, *m*, superficial larger portion of the submaxillary gland lying over the posterior part of the mylo-hyoid muscle.

The *tongue* is the organ of the sense of taste. Its structure being largely muscular, gives it considerable freedom of movement. Its surface is covered by a mucous membrane similar in its structure to the skin. The roughness of the tongue is due to little eminences called papillæ. In certain of these papillæ, namely,

the large ones near the root of the tongue (see *f*, in figure), and those which the eye detects scattered over the surface of the tongue, is believed to reside the sense of taste.

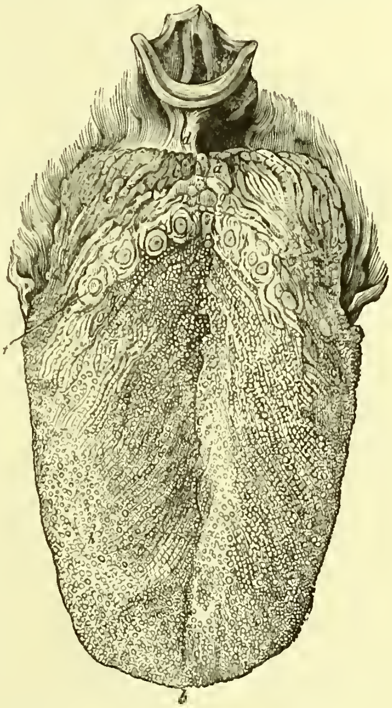


FIGURE 98.—The tongue: *f*, large papillæ at the base of the tongue; *b*, tip of the tongue.

Œsophagus or Gullet.

When the food has been properly prepared for swallowing by the process of mastication, it is thrust by the tongue back to the soft palate. So much is voluntary; but when the bolus of food has passed the soft palate, an involuntary and sudden action of the muscles takes place: the larynx is drawn up and is covered by the base of the tongue, which has been pushed backward in the act of carrying the food. The epiglottis is scarcely needed to protect the larynx from solid food, but without it liquids are likely to enter the air-passages. At the same time the muscles of the pharynx contract from above downward, and force the bolus through the pharynx to the *œsophagus or gullet.* The passage of liquids upward into the posterior nares is prevented by the drawing upward and backward of the soft palate, until it is met by the upper constrictor muscle of the pharynx. If, while liquid is in the pharynx, the tension of the muscles is let up, as in an attempt to speak or in sudden laughter, the liquid will probably be driven into the posterior nares and out through the nostrils—an accident often seen among children at table. If the muscles of this region be paralyzed, as, for instance, after diphtheria, such accidents are of constant occurrence. The gullet, being a muscular tube, carries the food onward to the *stomach.*

Stomach.

This is a large pouch-like organ which has three coats: the outer or peritoneal coat, the muscular coat, and the mucous or internal coat. The muscular coat has longitudinal and circular

fibres ; the mucous membrane is soft and velvety, with polygonal depressions called the "pits of the stomach." Into these pits empty a multitude of small glands. Near the lower end of the stomach these glands secrete mucus, but elsewhere they secrete the gastric juice, a very important agent in digestion. These glandular organs, called the follicles, also have the power of rapidly absorbing liquid from the stomach. The gastric juice contains, besides several chlorides and phosphates, and perhaps some free acid, a peculiar organic element called pepsine, which is a powerful digestive agent. The action of this juice upon meats is to dissolve the connective tissue and the sarcolemma, and to break up the bundles of muscular substance. It changes albumen into a similar substance called albuminose or albumen-peptone. Casein undergoes a similar change into casein-peptone. Fats are not digested in the stomach, but solid animal fats are there set free by the digestion of the vesicles holding the fat, Sugar is slowly changed to grape-sugar, which is assimilable. Starchy foods are not changed in the stomach.

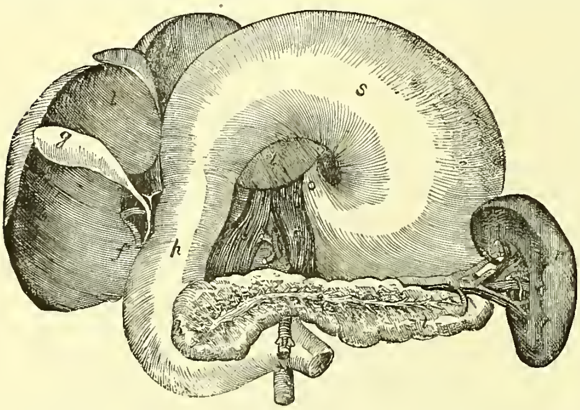


FIGURE 99.—The liver *l*, and the stomach *s*, have been turned upward to show the pylorus *p*, duodenum *d*, gall-bladder *g*, common bile-duct *f*, pancreas *h*, *t*, and spleen *r*.

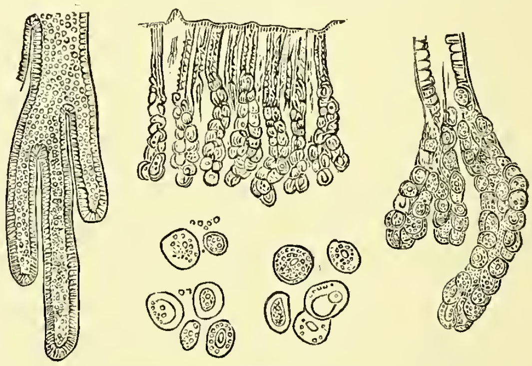


FIGURE 100.—Glands of the stomach.

When food has been taken into the stomach, that organ goes through certain characteristic movements to facilitate the mixing of its contents with the gastric juice. Both the inlet and outlet of the stomach are closed by the contraction of muscular fibres. Near the pyloric (right) end a particularly marked muscular contraction separates the stomach, so to speak, into a greater and lesser pouch. The food, coming into the stomach, passes to the right around the

greater curvature of the stomach into the smaller pouch, and if not yet sufficiently softened for passing into the intestines, it passes back again along the upper border of the stomach to again make its round. The time of ordinary stomach-digestion varies with individuals as well as with the character and amount of food taken. The average time for the digestion of a mixed meal would be between two and four hours. During this process a large quantity of gastric juice is poured out: the entire amount for a day is believed to be about fourteen pints. But this is not a drain upon the system, since it is as constantly being reabsorbed. Very much of the digestible part of our food, having been dissolved, is absorbed immediately from the stomach by the blood-vessels. Such parts as are not absorbed by the stomach, the fatty, starchy, and saccharine matters, refuse matters, etc., pass through the pyloric orifice into the small intestine.

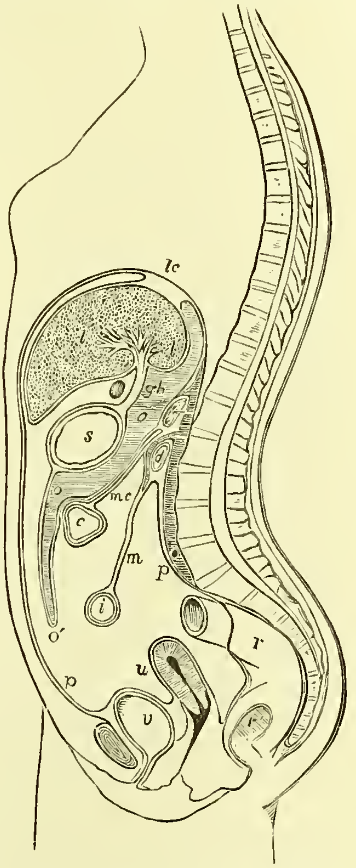


FIGURE 101.—Diagram showing the folds of the peritoneum lining the abdomen and covering its contents; the relations of the principal organs in the abdomen and pelvis: *l*, liver; *s*, stomach; *o*, omentum; *c*, colon; *m*, mesentery; *i*, intestine; *p*, peritoneum; *r*, rectum; *u*, uterus; *v*, bladder.

Small Intestine.

The *small intestine* is a tube from fifteen to twenty feet in length, and about an inch and one-quarter in diameter. It is kept somewhat in position by a double fold of peritoneum, called the *mesentery*. As the mesentery is three or four inches wide, considerable freedom of movement is permitted to the intestine at its upper extremity, adjoining the pyloric orifice of the stomach, and at the lower extremity where it empties into the large intestine; the remainder has much less freedom of movement. The intestine is divided, in description, into the duodenum, the jejunum, and the ileum. The *duodenum*, so called because its length is about equal to twelve fingers' breadth, is the part immediately adjoining the pylorus. The *jejunum* lies next, including the upper two-fifths of the intestine, the lower three-fifths being the *ileum*. There is no especial point of division between the latter two portions.

The intestine has three coats, the external, serous, or peritoneal; the middle, muscular; the internal or mucous.

The mucous coat is velvety and thickest at the upper extremity, gradually thinning downward. It is marked, especially in the upper part, by transverse folds, which from their moving to and fro have obtained the name of "valvulæ conniventes" (the little winking valves); these increase the extent of the mucous surface. Beneath the mucous membrane of the duodenum are glands shaped like a bunch of grapes, called the glands of Brunner. Throughout the large and small intestine are tubules called the follicles of Lieberkühn. The velvety appearance of the intestinal mucous membrane is due to the immense number of small projections, called *villi*. These are more abundant in some places than in others, but the average is estimated at 7,200 per square inch, or about 10,-125,000 in the entire small intestine. Each villus is an elevation of the mucous membrane, containing an artery and vein and a capillary network. Besides there are found in the lower part of the bowel glands, called the "solitary glands," and collections of the same glands, called "Peyer's patches."

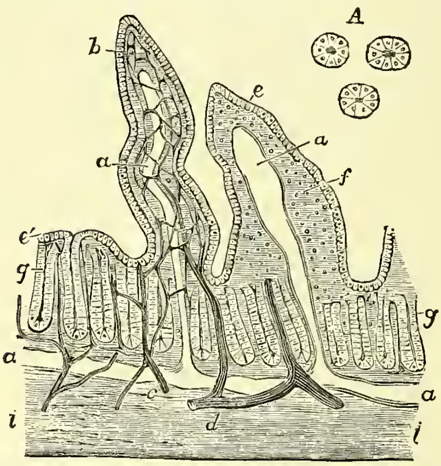


FIGURE 102.—Vertical section of the intestinal mucous membrane of the rabbit; magnified 150 diameters. Two villi are represented, in one of which the dilated lacteal alone is shown; in the other the lacteal and blood-vessel are both given; the former being white, the latter dark. The section is carried through the tubular glands into the tissue lying beneath the mucous membrane: *a*, the lacteal vessel; *b*, capillary blood-vessel; *c*, a small artery; *d*, a vein; *e*, epithelium; *f*, substance of a villus; *g*, tubular glands of Lieberkühn; *i*, submucous tissue.
A, some of the glands of Lieberkühn, cut across and more highly magnified.

The glands of Brunner, the patches of Peyer, and above all, the follicles of Lieberkühn, secrete the liquid known as the intestinal juice. Of the nature and action of this intestinal juice less is known than of the other digestive secretions. It continues the changes of starch into sugar, and the digestion of albuminoid substances begun higher up in the alimentary canal.

Into the duodenum empty the ducts of two important digestive glands. The pancreas, or sweet-bread, and the liver.

Pancreas, or Sweet-Bread.

The *pancreas* in man is about seven inches long, by one and a half wide at its largest part, which is attached to the duode-

num. It extends across the back of the abdominal cavity nearly to the spleen. Its duct enters the back of the duodenum by an opening common to it and the common duct from the liver and gall-bladder. (See Fig. 90.)

The secretion of the pancreas (pancreatic juice) is alkaline, and has from seven to nine parts in a hundred of a peculiar organic substance, called pancreatine. This juice is the chief agent in the digestion of fats, reducing them to a fine permanent emulsion like milk. Starch, as it is generally taken in cooked forms, in which the starch has already been acted upon by water, or hydrated, is partly changed to glucose by the saliva mixed with it; this change is much more rapidly carried on by the pancreatic juice, with some assistance from the intestinal juice; the pancreatic juice, however, is the most active agent. It also has a similarly prominent office in the digestion of sugar; still farther, it completes the digestion of albuminoid substances begun in the stomach.

Liver.

The *liver* is the largest gland in the body, having an average weight of four and a half pounds. It is situated just below the diaphragm on the right side (see Fig. 105). The upper surface of the liver is convex, and is divided into the right and left lobes, the former being much the larger. The under surface is concave, and in relation to the stomach and duodenum. On this surface, between the right and left lobes, are two smaller ones lying before and behind. Between these lobes is the transverse or *portal* fissure. Into this enter the portal vein, the hepatic artery, and nerves, the hepatic duct and lymphatics. The liver is covered by the peritoneum and its own proper coat, which is thin but strong. The substance of the liver is made up of lobules about $\frac{1}{25}$ of an inch in diameter; between these are spaces in which ramify vessels, nerves, and the branches of the duct of the liver (hepatic duct). The vessels, etc., entering at the portal fissure are covered

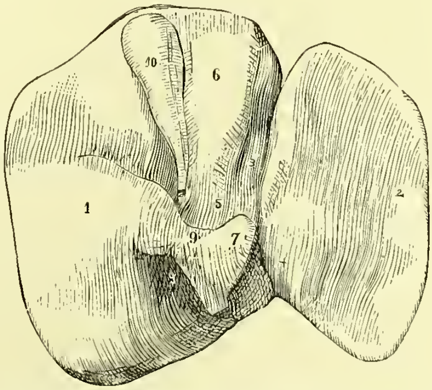


FIGURE 103.—The liver seen from its under side: 1, right lobe; 2, left lobe; 3, 4, longitudinal fissure; 5, transverse fissure; 6, lobus quadratus; 7, lobus Spigelii; 9, notch occupied by the vena cava; 10, gall-bladder.

by a fibrous sheath, called Glisson's capsule, and this breaks up between the lobules. The hepatic artery reaches the spaces between the lobules; the portal vein likewise breaks up into minute *inter*-lobular veins. Some veins penetrate the lobules, and there form a plexus. In each lobule the blood is collected from this plexus into a central *intra*-lobular vein, the intra-lobular veins unite into larger ones, which finally form the hepatic vein. The lobules are composed of liver-cells, between which are capillary blood-vessels, and also fine canals or spaces which communicate

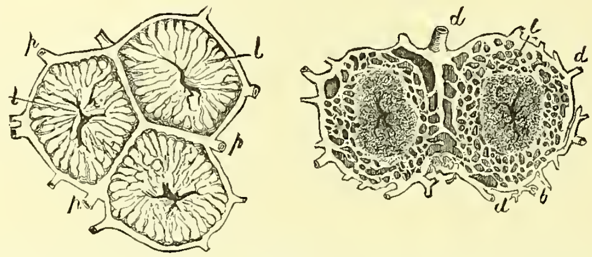


FIGURE 104.—Diagrams showing the arrangement of blood-vessels and bile-ducts within and between the lobules of the liver. Twenty times the natural size. *pp*, inter-lobular branches of portal veins; *l l*, intra-lobular branches; *h*, commencement of hepatic vein; *d d*, commencement of the hepatic duct.

with the branches of the hepatic duct between the lobules. The ducts make a remarkable net-work throughout the liver, and unite to form two principal trunks, one from the right and one from the left lobe, and the junction of these last forms the hepatic duct. After running about an inch and a half, it unites with the duct of the gall-bladder to form the common duct, which empties into the duodenum.

The *gall-bladder* is a pear-shaped bag lying beneath the liver about midway of its length, and near its anterior margin. It is simply a reservoir for bile.

The quantity of bile secreted in twenty-four hours is estimated at about two and a half pounds. Its flow varies in rapidity, being greatest between two and eight hours after eating, it then falls off again. The bile stored in the gall-bladder is collected during fasting, and during digestion it is discharged into the duodenum.

The bile is variable in color, being within the limits of health from a yellowish-green to a reddish-brown. It is viscid and alkaline. Besides the coloring matter, it contains two salts peculiar to it, viz.: the taurocholate and glycocholate of soda.

The function of the bile is obscure. So far as is known it is not a digestive fluid, that is, it is not concerned in the digestion of any kind of food, yet if it be not introduced into the intestinal canal

(as when the liver is extensively diseased, or when the entire quantity of bile is brought by an artificial opening externally to the body in animals), the person or animal dies of inanition. It stimulates the peristaltic action of the bowels, but the latter is not entirely dependent upon the presence of bile in the intestines.

The bile is also considered as possessing an excretory function. A crystalline substance, known as cholesterine, is formed in the nervous system and taken up by the blood. This is found in the bile, and it is now believed that the excretion of the cholesterine, as a substance unfit for retention in the economy, is a part of the function of the liver.

It is a remarkable fact that the blood of the hepatic vein contains sugar always. During life sugar cannot be found in the liver, because, it is believed, the current of blood constantly washes it away as soon as formed. Instead, there is found a substance known as the glycogenic, or sugar-forming matter. After death the cessation of the flow of blood through the liver permits a very considerable accumulation of sugar in that organ. The production of sugar is increased during digestion and varies with food, being greatest when vegetable, and especially saccharine food is taken. This peculiar function is under the control of the nerve-centres, and if the floor of the fourth ventricle of the brain be mechanically irritated, the animal becomes presently diabetic, *i.e.*, the urine contains sugar.

The sugar formed by the liver probably has the same use in the system as sugar from food, as we have seen a part of the food digested was absorbed by the stomach directly. The remainder passes on to be mingled with bile, the pancreatic and intestinal juices. In the villi of the small intestine originate those lymphatics which are called lacteals, from the fact that after digestion they appear to be distended with milk. These lacteals absorb from the digested food, now called chyle, such parts as can be appropriated by the system, and the remainder passes, as waste, onward to the large intestine.

Large Intestine.

The *large intestine* is about five feet in length, is from one and one-half to three inches in diameter, and somewhat sacculated. The small intestine enters into it, the opening being guarded by a valve to prevent the return of matter to the small intestine. The beginning of the large intestine is known as the cæcum or blind gut, the remainder (extending upward on the right side of the abdomen, across its upper part and downward upon the left side to

the rectum) is called the colon, its parts being called respectively the ascending, transverse, and descending colon. Just before its junction with the rectum it has an S-shaped course, called the sigmoid flexure. From the cæcum extends the vermiform or worm-like appendix, a small piece of bowel from one to five inches long, and of the size of an ordinary lead-pencil. This has no known physiological use, but is often the source of fatal inflammations.

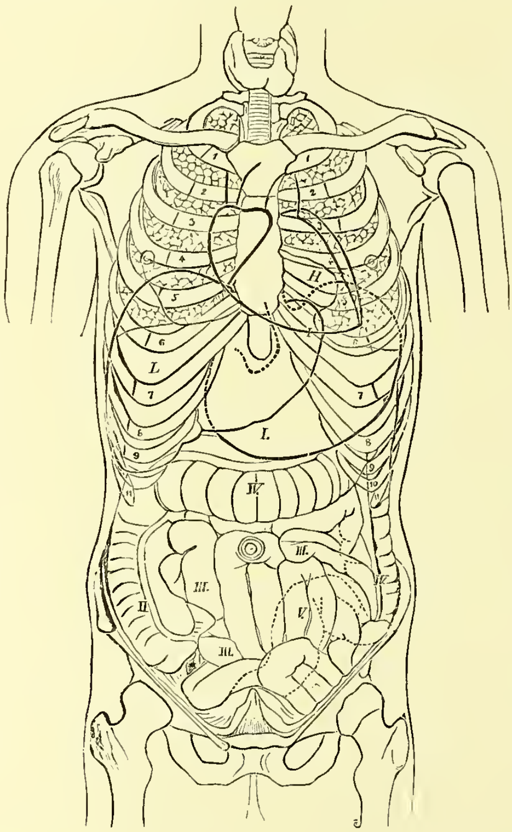


FIGURE 105.—Diagram showing the relation of the various organs of the body to each other and to the surface. (Seen from in front.) I., the stomach; II., commencement of the colon; III., small intestine; IV., transverse and descending portions of the colon; V., rectum (dotted lines); the numbers 1 to 11 indicate ribs.

The large intestine rarely absorbs anything but watery substances. It receives excreted matters and waste materials passed on from the small intestine. The contents of the large intestine are called fæces. They are moved forward by the muscular coat of the great intestine, and are stored for a time probably at the sigmoid flexure. Periodically the fæces are pushed around into

the lower bowel or rectum, causing a sensation of desire of evacuation of the rectum, or defecation. If this be not yielded to, the sensation passes off, probably from the re-ascent of the fæces. The rectum is ordinarily empty, except in cases where the act of defecation has been persistently neglected, or in cases of disease.

The *rectum* is guarded by an internal and external sphincter,

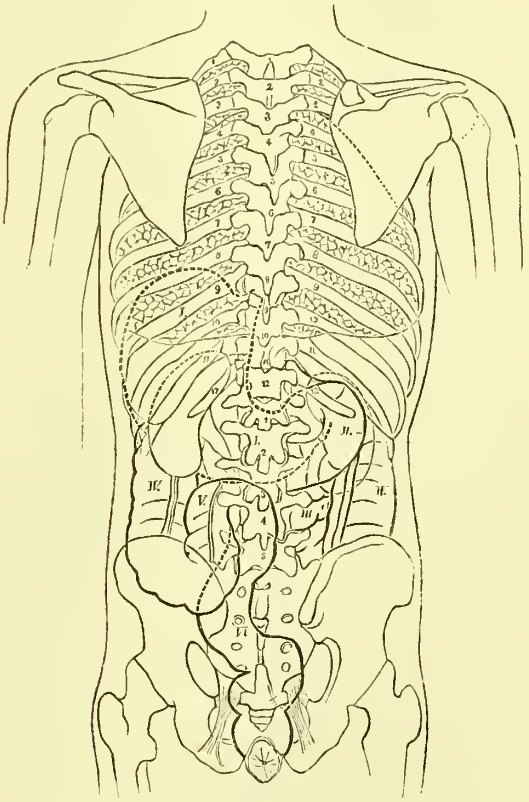


FIGURE 106.—Diagram showing the relative situations of various organs of the chest and abdomen, as seen from behind. The numbers are placed on the ribs and spinous processes of the vertebræ: I., stomach; II., duodenum; III., small intestine; IV., large intestine; V., VI., rectum; II. is also placed at about the centre of the right kidney.

the latter being to a very considerable degree under voluntary control. The act of defecation is accomplished by the fixing of the anus by the levator ani muscle, the external sphincter relaxes, the muscular coat of the rectum contracts and expels the contents. If the act be in any way difficult, the abdominal muscles, and particularly the diaphragm, contract to bring pressure upon the abdominal organs, and so to empty the bowel.

In health a certain amount of gases is generally found in the

stomach and bowels. If they have a function it is probably mechanical simply.

Peritoneum.

The *peritoneum* is a serous membrane lining the cavity of the abdomen, and enveloping wholly or in part all the abdominal viscera in such a manner that none of them are within the cavity of the peritoneum, which is a shut sac. The double folds of peritoneum that bind the small intestine, the large intestine, and the rectum to the spinal column, are called respectively the mesentery, the meso-colon, and the meso-rectum (see Fig. 101).

A double fold that falls from the anterior surface of the stomach, nearly to the pubis, and rises again to the colon, is called the omentum or apron.

Glands without Ducts.

There are in the body a number of organs denominated *ductless glands*. These are the *spleen*, the *supra-renal capsules*, the *thyroid* and *thymus* bodies. The largest of these is the spleen. It is a large, flattened, oblong organ, about five inches in length, three or four in width, and an inch thick. Its weight is about seven ounces. Its color is bluish. Its position is in the left hypochondriac region, next to the cardiac end of the stomach. The spleen has for a frame-work a fibrous net-work. This is filled with a soft substance called the spleen-pulp, and certain closed follicles, called Malpighian bodies, are found in connection with the blood-vessels. Nothing is certainly known as to the function of the spleen. It has often been removed from animals, and sometimes from human subjects without apparent damage to the vital functions. It has been observed that some dogs thus operated on become very ravenous and very ferocious. But the same results sometimes follow some other operations (see Fig. 99).

The *supra-renal capsules* are little organs lying above the kidneys. Of their function nothing is surely known, but from observations of a peculiar disease, known as "bronzed skin," or "Addison's disease," it is probable that they have some influence on the manufacture of pigment or coloring matter in the system.

The *thyroid* gland is attached to the larynx, the *thymus* is situated a little lower down. We have no knowledge of their uses.

LEROY M. YALE, M.D.

Hygiene—Food and Air.

BY

EDWARD H. JANES, M.D.,

PROFESSOR OF HYGIENE IN THE WOMAN'S MEDICAL COLLEGE OF THE NEW YORK INFIRMARY; ASSISTANT SANITARY SUPERINTENDENT OF THE HEALTH DEPARTMENT OF THE CITY OF NEW YORK; SECRETARY OF THE AMERICAN PUBLIC HEALTH ASSOCIATION.

FOOD.

Animal life is characterized by continuous phenomena of waste and repair. The slightest movement or action on the part of any living being, whether that action be voluntary or involuntary, whether physical or mental, be it an exhibition of brute force or a simple act of the will, is necessarily attended with some waste of animal tissue. The wielding of the sledge by the stalwart laborer, the quiet application of the student, the anxieties of the man of business, the drawing of the breath and the beating of the heart, alike depend for their support upon the combustion of a certain amount of animal tissue within the body, developing animal heat, and thus supplying the amount of mechanical force necessary for keeping the animal machine in motion. This gradual waste of animal tissue calls, in its turn, for a compensating process of repair; and that this may be effected without interruption, and the animal mechanism preserved in its integrity, the sensation of hunger is experienced and food is taken, which not only satisfies the immediate cravings, but, after undergoing the process of digestion and assimilation, contributes to the formation of living tissue, repairs waste, and insures growth through the several stages of infancy, childhood, and youth, preserves the necessary equilibrium of loss and repair in middle life, and regulates the waste and retards decline during the period of old age.

In discussing the qualities of the various alimentary substances, and the offices which they severally perform in nourishing the body and supplying its wants, authors have usually divided them into two general classes: viz., those which contribute to the repair of waste and the formation of tissue, and those which are directly concerned in the development and support of animal heat. The terms plastic and respiratory foods have been applied to these two general divisions, indicating, as these terms signify, the promotion of growth and repair as accomplished by the one class, and the generation and support of animal heat, with the development of force, by the other.

The former of these two general divisions embraces two distinct groups of alimentary substances: those belonging to one group are called nitrogenous foods, from the fact that nitrogen enters largely into their composition, and is contained largely in animal, and to a considerable extent in vegetable foods. Those of the other group, although containing no nitrogen, are indispensable in that they contribute to the building up of certain portions of the body, and are known as the mineral elements of food. This group embraces a number of substances, and yet only two of them (water and salt) are furnished separately, all of the others existing in combination with the various articles of food in common use.

The second general division consists principally of the starches (or *amylaceous* substances), the sugars (or *saccharine* substances), and the fats (or oleaginous substances); and as they contain no nitrogen, but consist of carbon, oxygen, and hydrogen, they are called non-nitrogenous substances or hydro-carbons. As none of the articles of food in use can be said to belong exclusively and entirely to either one of these general divisions, the true value of any one of them must be estimated by the nature and proportions of the various nutritive elements which enter into its composition.

In speaking of the value of foods, we must not be understood as using the word in its commercial sense; for many of the more nutritive foods are of less commercial value than many others of inferior nutritive quality, the difference being due to superiority of flavor or scarcity of supply enhancing the money value of certain varieties, without reference to their physiological importance.

TABLE I.

Proportions of Different Foods required to yield 1,220 *Grains of Nitrogenous Matter.*

	Grains.	Pounds.		Grains.	Pounds.
Skim-milk cheese....	2,723	0.4	Rice...............	19,365	2.8
Lean meat...........	2,421	0.9	New milk..........	29,756	4.2
White fish............	6,740	1.0	Potatoes...	58,095	8.3
Fat meat............	8,971	1.3	Parsnips or turnips..	111,000	15.9
Fat bacon............	12,449	1.8	Beer or porter......	1,110,000	158.6
Bread..........	15,062	2.1			

In order, then, to judge correctly concerning the value of different articles of food, let us see in what proportions they severally contain the various elements of nutrition, first enumerating these in their distinct groups, still keeping in mind the two general divisions—plastic and respiratory foods.

TABLE II.

Nutritive Equivalents, calculated according to the Amounts of Nitrogen in the Dry Substances, Human Milk being 100.

VEGETABLES.

Rice	81	Oats	138
Potatoes	84	White bread	142
Maize	100	Black bread	166
Rye	106	Peas	239
Radish	106	Lentiis	276
Wheat	119	Haricots	283
Barley	125	Beans	320

ANIMAL.

Human milk	100	Cheese	331
Cow's milk	237	Eel	434
Yolk of egg	305	Mussel	528
Oysters	305	Ox-liver	570
Pigeon	756	Veal	873
Mutton	773	Beef	880
Salmon	776	Pork	893
Lamb	833	Turbot	898
White of egg	845	Ham	910
Lobster	859	Herring	914
Skate	859		

The plastic substances, as has been already stated, are the nitrogenous, which are organic, and the minerals, which are inorganic. The former are *fibrin*, which is the principal constituent in lean meat, and is of importance as a flesh-forming food; *casein*, the curdy portion of milk, and the main constituent in cheese; *albumin*, an important constituent in animal fluids, and forming the greater part of the white of eggs; *gelatin*, obtained chiefly from bones and tendons, and, although of not much nutritive value, is of some use in the form of soups and jellies; and *gluten*, the adhesive principle of grain, which is similar to fibrin, and to a certain extent may be substituted for it. These are all flesh-forming foods; they contribute to the building up of the body, and if any one of them chance to be absent from our daily food, the deficiency may be met by an increased proportion of some one of the others.

The mineral group includes *water* and the various metallic, alkaline, and earthy *salts*, which assist in making up the different tissues of the body, into the composition of which water enters largely, there being about one hundred and eleven pounds in a human body weighing one hundred and fifty-four pounds. The

saline substances form a comparatively small proportion of the tissues of the body, the aggregate being not far from eight pounds in the body of an ordinary man ; yet they are several in number, each having its proper office to perform. But little care is generally bestowed upon this important group of our food-elements, and it is therefore fortunate that, without any effort on our part, they are supplied by nature in combination with the food we daily consume. Says Dr. Lankester : "The table of constituents of food indicates these mineral matters of our food, and to which people, generally speaking, attach very little importance. Persons who prepare our food—cooks in the kitchen, ladies who superintend cooks and order dinners for large families—and people who consume food from day to day, never think of asking whether food contains the right proportion of those ingredients to secure health. Yet, without these, babies get rickets, young ladies acquire crooked spines, fathers get gouty, and mothers have palpitations ; and they do not, however, think of ascribing these things to the food which has deprived them of the proper constituents of their blood."

Of the various mineral substances which assist in making up a complete diet, water and common salt are the only two that are taken directly from nature, the others being present in both animal and vegetable food, and are furnished to the system respectively in proportion to the varieties of food taken. Concerning *water* little need be said, save that it not only enters largely into the composition of our tissues, but, being nature's great solvent, it has an important office to perform in aiding the digestion and assimilation of our food. It is also the great cleansing agent, and, after serving as a vehicle to convey new matter to the various tissues, it next dissolves and removes from the body its impurities or waste matter by the kidneys, the bowels, the skin, and the lungs.

Common salt, though not present in the solid tissues, is an important element in the blood, and is taken directly from the mineral kingdom. It not only supplies the blood with one of its essential constituents, but it also furnishes an aid to the digestion of our food, for, being a chloride of sodium, it supplies to the gastric juice the hydrochloric acid it contains—an important agent in the process of digestion. It is also of value in preserving meat and fish from putrefaction, though persons living for a great length of time on meats so preserved are liable to the disease called scurvy if this tendency is not counteracted by the use of foods containing some of the other mineral substances to be mentioned soon.

Phosphate of lime is another important mineral substance of food. It constitutes the earthy matter of bone, and, according to Dr. Lankester, five pounds thirteen ounces of it are contained in a

human body weighing eleven stone, or one hundred and fifty-four pounds. There are other phosphates in the system, which are generally supplied from the cereal grains, and, to some extent, from animal food.

The *salts of potash* are furnished by the potato and other vegetables. If we would avoid the evil effects of a diet of salt meat, we must make use of such vegetables as are rich in the salts of potash, as the potato, the cabbage, the radish, turnip, and many others. Sailors who live chiefly on salt meat and "hard tack" are protected from scurvy by the use of lemon juice or lime juice; these fruits containing potash in combination with a vegetable acid. Other mineral elements of food are required in order to constitute a perfect diet, a general idea of which may be obtained from the following summary statement, given by Edward Smith, of the principal materials of which the body is composed:

"*Flesh*, in its fresh state, contains water, fat, fibrin, albumin, and gelatin, besides compounds of lime, phosphorus, soda, potash, magnesia, silica, and iron, and certain extractive matters.

Blood has a composition similar in elements to that of flesh.*

Bone is composed of cartilage, gelatin, fat, and salts of lime, magnesia, soda, and potash, combined with phosphoric and other acids.

Cartilage consists of chondrin, which is like gelatin in composition, with salts of soda, potash, lime, phosphorus, magnesia, sulphur, and iron.

The brain is composed of water, albumin, fat, phosphoric acid, osmazome, and salts.

The liver consists of water, fat, and albumin, with phosphoric and other acids in conjunction with soda, lime, potash, and iron.

The lungs are formed of a substance resembling gelatin, albumin, a substance analogous to casein, fibrin, various fatty and organic acids, cholesterin, with salts of soda, and iron and water.

Bile consists of water, fat, resin, sugar, fatty and organic acids, cholesterin, and salts of potash, soda and iron."

Hence it is requisite that the body should be provided with salts of potash, soda, lime, magnesia, sulphur, iron, and manganese, as well as sulphuric, hydrochloric, phosphoric, and fluoric acids, and water; also nearly all the fat which it consumes daily, and probably all the nitrogenous substances which it requires, and which are closely allied in composition, as albumin, fibrin, gelatin, and chondrin. It can produce sugar rapidly and largely, and fat slowly and sparsely, from other substances; also lactic, acetic, and various organic acids and peculiar extractive matters.

The various salts mentioned above are taken into the system sometimes with the water we drink, sometimes with our animal

---

* With the addition of chloride of sodium, or common salt.

food, and again in our vegetables, the proportions varying in proportion to the nature of the soil from which they are produced. In boiling vegetables, portions of their mineral constituents are dissolved by the water used in cooking, and the cook who uses the water in which vegetables have been boiled in making her soup, saves many of these important elements of nutrition.

The respiratory foods include the starches, the sugars and the fats. The gums also belong to this class, but they are of less importance than the others. *The starches* are abundant in vegetables, particularly the potato and the cereal grains, and form a large portion of our daily food. The preparations of arrowroot, sago, and tapioca are different forms of starch, having dietetic qualities similar to those of the corn-starch, fine wheat flour, or the potato. Starch is not digested as starch, but is previously converted into sugar. This change is effected by the chemical union of starch with a little more water than it already has, or what is the same thing, the addition of hydrogen and oxygen in the proportions in which these gases chemically unite to form water. This may be illustrated by the ordinary symbols thus: The composition of starch being $C^{12}H^{20}O^{10}$, by adding two atoms of H^2O (water) we have $C^{12}H^{24}O^{12}$, or $C^6H^{12}O^6$, which is the composition of glucose or grape sugar. This process of the conversion of starch into sugar commences as soon as the starch comes in contact with the saliva, and is continued by the fluids of the alimentary canal, and by this conversion starch which is itself insoluble, finds its way into the circulation and performs the office of a heat-forming food.

Sugar is contained in the grasses and in many esculent roots, particularly the beet, the carrot, the sweet potato, and in the juices of most fruits. It is obtained largely from the sugar-cane, from the *Sorghum saccharatum*, sometimes from the beet, and in some portions of this country in considerable quantities from the sap of the sugar maple. Although sugar varies in form according to the source from whence it is derived, yet its ultimate action, in whatever form taken, is the same; and being already soluble, it is more readily absorbed into the blood than starch, and hence its adaptability to the wants of children, especially young infants before the development of the salivary glands, for whom nature has provided by the generous proportion of this necessary substance in the mother's milk.

The next group of alimentary substances to be mentioned is that of the *fats*, including oil, butter, lard, suet, the fat of meat, and, indeed, fat from whatever source obtained, whether from the

animal or vegetable kingdom. Fat is more of a heat-forming food than either starch or sugar, as may be readily seen from the chemical composition of each. Fat, starch, and sugar consist each of three elements: carbon, hydrogen, and oxygen, in different proportions. The two latter elements, as has already been said, are contained in starch in the same proportions in which they unite to form water, while in fat the proportion of oxygen is much less, the formula being $C^{11}H^{10}O^{1}$, giving a large amount of hydrogen to be consumed by combustion with the carbon.

We must not forget that the combustion of these substances within the body is precisely the same as the combustion of fuel without, it being merely the union of oxygen with the combustible body, the only difference being that in the former case the process is much slower than in the latter. Animal heat in the human being must be maintained at the temperature of about 98½° Fahr., and it cannot vary much in either direction without serious consequences. It is the combustion of carbon and hydrogen that maintains the animal heat at the proper standard, while the evaporation of fluid from the surface of the body prevents an accession of heat which would otherwise prove fatal. Now fat, as is seen by the formula, is nearly all combustible, and hence to obtain an equal result a much less quantity of fat may be substituted for a given quantity of starch, which yields only its carbon to combustion. We see, therefore, that not only our instincts and tastes, but our natural wants, require that we eat more bread than butter, or more potatoes than pork.

Liebig made a sharp distinction between the physiological action of the nitrogenous and that of the non-nitrogenous principles of food, maintaining that the former, in repairing the tissues, constituted the main source of animal motive power or energy, while the latter, by their oxidation, served only to maintain animal heat. But subsequent experiments have shown that while the oxidation of non-nitrogenous substances within the body develops and maintains animal heat, this same heat thus developed is the source of muscular power, and while the nitrogenous elements alone nourish the tissues, their oxidation must also be a source of heat and power. We see, therefore, that we must not too sharply divide the offices performed by these two classes of food substances, especially as it regards their effects in the production of animal heat and "potential energy;" but while it seems to be well established that oxidation of non-nitrogenous substances within the body is the principal source of animal heat and muscular power, we must also admit that the decomposition of tissues contributes somewhat to the same result.

Every degree of heat has its equivalent of motive power, and it has been ascertained that the amount of heat which is required to raise the temperature of one pound of water one degree Fahrenheit is equivalent to the mechanical power required to raise a weight of 772 pounds one foot in height, or, what is its equivalent, to raise one pound weight to an elevation of 772 feet. If, then, we would sustain to its proper temperature our animal heat, and thus be enabled to endure successfully the cold of winter; if we would, moreover, promote our physical endurance and preserve a constant supply of physical force, we must associate with our daily food a generous proportion of these heat-forming elements—starches, sugars, and fats.

The surplus fat, or that which is not at once consumed in the body, has also its particular functions. By being deposited in different parts of the system it serves to round off the inequalities of surface, giving to the muscles and limbs a plump and shapely appearance; forms a soft cushion for the nerves, protecting them from pressure against the harder tissues; by being deposited around the joints it diminishes their friction and renders them supple in their movements; and, in short, gives to the entire surface of the body that perfection of outline seen only in the well-developed person of a human being. Being a bad conductor of heat, a moderate supply of fat deposited beneath the skin, between the muscles, and around the joints, serves to prevent, in a measure, the escape of animal heat from the system; and hence, the fat man can do with a less amount of clothing than is required to protect the lean man from cold, the heat generated by this internal combustion having a tendency to escape more rapidly from the latter than from the former.

Although fat as an article of diet is furnished largely from the animal kingdom, and taken in the form of fat meat, lard, suet, and butter, yet much is also obtained from the various vegetable productions which contribute to our daily supplies. Starch and sugar are also, doubtless, to some extent converted into fat within the system, and therefore persons who cannot eat fat meat (and there are many such) may have recourse to other articles of diet, from which they can obtain not only an adequate supply of fat to meet all the wants of the system, but in some instances even a condition of obesity may be produced.

Where such a condition of excessive fatness has been produced, it may be due partly to some natural peculiarity of the constitution, and partly to causes which we are able to control; and persons affected in this manner will find it to their advantage to abandon all alcoholic liquors, to limit their indulgence in saccharine

and oily foods, give up sedentary occupations, and be much in the open air, taking a good deal of moderate exercise. This course is much to be preferred to what is called Bantingism.* Mr. Banting succeeded in reducing his proportions by abandoning such foods as produce fat, and substituting a diet composed wholly or chiefly of the plastic foods. The evil likely to result from this practice is that the system is overloaded with nitrogenous waste, to get rid of which the kidneys are taxed beyond their capacity for work, and a condition is induced which is known as Bright's disease [see Index, Vol. II.], dooming the individual to a long period of suffering, to be relieved only by death.

No less hazardous are the practices sometimes resorted to by young girls who have a dread of becoming fat, of attempting to reduce their plumpness by drinking vinegar, and to bleach their complexion by eating quantities of uncooked rice. The first is successful so far only as it retards or impairs the function of digestion, which is equivalent to a process of semi-starvation, while the second diminishes the appetite for suitable food, interferes with assimilation, and produces constipation. We should not attempt to interfere too much with the condition of nature. Many persons are by nature lean, and in this condition enjoy excellent health ; but leanness induced by interfering with the ordinary process of digestion and assimilation, is abnormal, and can only be secured at the risk of permanent injury to the constitution.

The following is a brief statement of some of the sources of fat in the vegetable kingdom, with the percentages, or the number of

---

* "His original dietary table, Mr. Banting tells us, consisted of 'bread and milk for breakfast, or a pint of tea with plenty of milk, sugar, and buttered toast ; meat, beer, much bread and pastry for dinner ; the usual meal of tea similar to that of breakfast ; aud generally a fruit tart, or bread aud milk, for supper.' For this he substituted—*Breakfast* at 9 A.M. : Five to six ounces of either beef, muttou, kidneys, broiled fish, bacon, or cold meat of any kind, except pork or veal ; a large cup of tea or coffee (without milk or sugar), a little biscuit, or one ouuce of dry toast ; making, together, six ounces of solids and nine of liquids. *Dinner* at 2 P.M. : Five or six ounces of any fish except salmon, herrings, or eels ; any meat except pork or veal ; any vegetable except potato, parsnip, beet-root, turnip, or carrot ; one ounce of dry toast ; fruit out of a pudding not sweetened, any kind of poultry or game, and two or three glasses of good claret, sherry, or Madeira—champagne, port, and beer forbidden ; making together ten to twelve ounces of solids and ten of liquids. *Tea* at 6 P.M. : Two to three ounces of cooked fruit, a rusk or two, and a cup of tea without milk or sugar ; making two to four ounces of solids and nine of liquids. *Supper* at 9 P.M. : Three or four ounces of meat or fish, similar to dinner, with a glass or two of claret or sherry aud water ; making four ounces of solids and seven of liquids. With this change of diet Mr. Banting states that he fell in weight from fourteen stone six pounds to eleven stone two pounds in about a year."—PAVY "On Food and Dietetics."

parts of fat, in a hundred parts of each one of the vegetable substances included in the list, as given by recent authorities :

Wheat flour	2.0	Potatoes	0.2
Oatmeal	5.6	Carrots and turnips	0.2
Indian meal	8.1	Parsnips	0.5
Rye flour	2.0	Peas	2.1
Barley meal	2.4	Tea	4.0
Buckwheat	1.0	Coffee	13.0
Rice	0.7	Cocoa	50.00

Among the other sources of fat in the vegetable kingdom are many of the seeds of plants, especially the edible nuts, which are largely used, either at the table or otherwise, as delicacies rather than as ordinary food : as the almond, both the sweet and bitter—the former eaten plain, and also used a good deal in the making of cakes and confectionery, while the latter is valued principally for the essential oil it yields. Large quantities of oil are also expressed from the sweet almond and devoted to other purposes than food. The chestnut, the walnut, the Brazil nut, and many others in common use, are all rich in fat, and may be eaten with advantage by persons whose stomachs reject fat meat. The olive yields large quantities of oil from the ripe fruit, which is known as olive oil, or sweet oil. When used as food, olive oil is taken chiefly in the form of salad dressing, and is considered very wholesome, aiding in the digestion of the most hearty meal.

From what has been said of the offices performed by the different groups of alimentary substances, it is evident that in order to constitute a perfect diet it is important that each group be sufficiently represented. Could we select a diet composed of nitrogenous foods, such as lean meat, cheese, eggs, etc., all deprived of their mineral elements, the result, before long, would be death from want of nourishment. If we add to the above a generous supply of fats and starches, without the minerals, the result will still be a gradual course of starvation. If either one of the other groups could be thus entirely excluded from our diet, the result would be no less serious, while even a partial exclusion would result in malnutrition in proportion to the degree of deficiency in any one essential element of food. As nature has already supplied the necessary combination of food-elements in all of our animal and vegetable productions, it is a matter of interest to us that we are not only able to make the proper selections, but that we so treat our meats and vegetables, in preparing them for the table, as not to deprive them of any of their qualities necessary for our complete sustenance.

ANIMAL FOOD.

In our examination of different articles of food, we will first direct our attenti n to those supplied from the animal kingdom, as containing a greater proportion of the plastic, with a considerable amount of respiratory food, and as being well adapted to our wants. In the class of animal foods we must include not only meats, but milk, butter, cheese, and eggs. These latter constitute, as we know, an important part of the diet of so-called vegetarians, and, taken in suitable quantities, with the proper amount and variety of vegetable food, they furnish a good degree of nourishment. As a rule, all animal foods are readily digested, being the product of a previous digestion of vegetable matter, and therefore much more concentrated and nutritious. It is the only form in which the crude vegetable productions of the soil, as the grasses, etc., can be made available to us ; that is, by first being submitted to the powerful digestive organs of the herbivorous animals, and coming to us, as it were, second-hand. The vegetable receives its nourishment directly from the soil and the atmosphere, which no living thing in the kingdom of animated nature can do. In its turn the vegetable contributes to the growth of the animal, thus supplying a nutritious food for man, who, at his dissolution, yields his remains to the soil, while the products of all animal waste, which we may say commences at birth, contribute to the support of vegetable life, our own nourishment being but a step in the organic cycle around which these forces of nature are ever active.

Milk.

As milk contains all of the elements necessary for healthy nutrition during the early period of life, it has been called a typical food, and, being an animal secretion, it is proper to place it at the head of the list of animal foods.* Milk is the best food for the

* Milk is composed of a clear fluid having floating in it a myriad of little globules of fat. When it is allowed to stand for a few hours these fat-globules rise to the surface and form a layer called cream. The clear fluid in which these fat-globules float contains, in solution, casein (or cheese), a sugar which is peculiar to milk, and therefore called sugar-of-milk, and a variety of salts, besides which there is a small quantity of mucus from the membrane lining the milk-tubes of the udder. It is chiefly this mucus which forms a scum on the surface of milk when it is boiled. Certain substances have the property of curdling the casein, the gastric juice being the most notable of them, and the active agent in rennet made from the stomach of the calf, as commonly used in the manufacture of cheese. When a thin layer of milk is examined under a microscope, the globules of fat present an appearance similar to that of the adjoining figures, and it is their comparative number which determines the richness or poverty of the sample.

human infant, as well as for the young of all mammalia, each kind thriving best upon that furnished by its own mother. It contains a large proportion of water, a certain amount of nitrogenous or

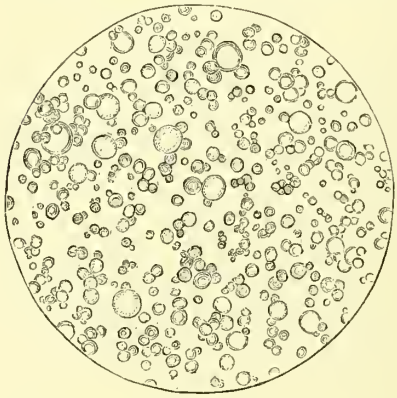


Fig. 107.

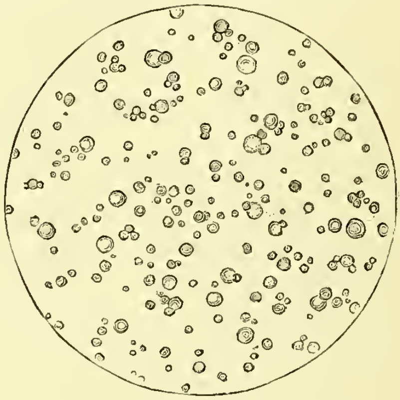


Fig. 108.

Figure 107.—(After Hassall.)—Cow's milk of good quality, as it appears when greatly magnified. The space is pretty evenly covered with numerous well-developed and shining drops of fat, floating in a clear fluid.

Figure 108.—(After Hassall).—Cow's milk of poor quality, as it appears under a microscope. Compared with the adjoining sample, it shows fewer, smaller, and less perfectly developed fat-globules.

plastic matter in the form of casein, the respiratory or heat-forming food in the fat and milk-sugar, and the mineral elements in the salts which it holds in solution.

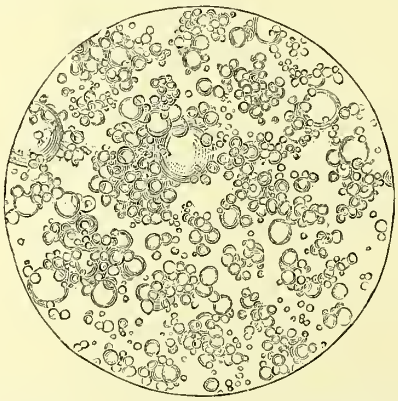


Figure 109.—(After Hassall.)—Cream from cow's milk, greatly magnified. While some of the oil-globules are relatively of natural size, others have united to form large, glistening drops. It is the hastening of this process by churning which separates the fat from the watery part of milk in the form of butter.

The proportions in which these constituents are found vary in the milk of different animals; but as cow's milk is the one generally used as human food, except for the nursing infant, we will

give here its average composition. In 100 parts of cow's milk there are of casein, 4.48 ; butter, 3.13 ; sugar, 4.77 ; salts, .60 ; and water, 87.02. These proportions, as well as the specific gravity, vary slightly with different animals, and also with the manner in which they are fed. The milk of the human mother varies considerably from that of the cow, in that it contains less casein, fat, and salts, and a larger amount of sugar ; and when the mother is, from any cause, unable to nurse her infant, and it becomes necessary to substitute cow's milk, the latter, if pure, should be made to approximate in composition as nearly as possible to the mother's milk by the addition of water and sugar, with a small amount of lime-water — the latter to prevent the milk becoming rapidly sour, which is often a cause of dangerous illness, and sometimes even fatal to the child.*

It is well known that children artificially fed have much less chance of living than those nursed by their mothers. Human milk does not so readily become acid as cow's milk, and as milk received from the breast is neither exposed to the air nor changed in temperature, it enters the stomach of the child perfectly fresh and in a condition to impart the most benefit, while we can never be quite sure that milk fed from a bottle has not already reached the incipient stage of change. We cannot, therefore, be too careful in cleansing a nursing-bottle immediately after it has been used. On no account should we allow any portion of the milk to remain for a future feeding, but the bottle should be thoroughly cleansed after each feeding, and then filled with a solution of soda to keep it perfectly sweet.

Taken with bread, oatmeal, or Indian mush, milk is an article of diet adapted to the wants of older children and adults, and in this way it is much used among farmers in different parts of this country.

Milk sold in cities is often diluted with water, or deprived of a portion of its cream, which, though not rendering it positively injurious, diminishes its nutritive value. This practice of diluting

---

* Besides the differences betweeu the milk of a cow and human milk, as above mentioned, it has beeu found, by those who have had experience in the artificial feeding of infants, that the casein of cow's milk, when taken into the stomach of an iufaut, is liable to form firm, bulky, and extremely indigestible curds, while the curdled caseiu of human milk assumes a softer and more finely-divided curd, which is readily acted on by the digestive fluids of the stomach. It has also been found that when something of a gelatiuous nature, like a thin size made of purified gelatin, or a well-cooked gruel of barley flour, is mixed with cow's milk, the acid of the gastric juice does uot attack the casein so readily ; a softer and more porous curd is formed, and its digestion is rendered easier. Neither the gelatin nor the barley are used in this case with a view to their being of any special value as foods, but simply to influence the formation of soft curds of caseiu.

milk has had the effect to lessen the general confidence in the honesty of the milkman, and about twenty years ago a new industry was developed, that of condensing milk to one-fourth of its original bulk by slow evaporation in vacuum-pans, and selling it under the name of condensed milk, of which there are now two varieties: one consisting of condensed milk alone, the other containing, in addition, a considerable amount of refined sugar. In the latter form, milk will keep for a long time, but its increased amount of sugar detracts from its value as a flesh-forming food. Condensed milk without the addition of sugar will keep for several days, and, although possessing no advantage over new milk undiluted, it insures to the city consumer a reliable article of food. It may be diluted when used, and the consumer is saved the expense of purchasing water at the rate of eight or ten cents per quart.

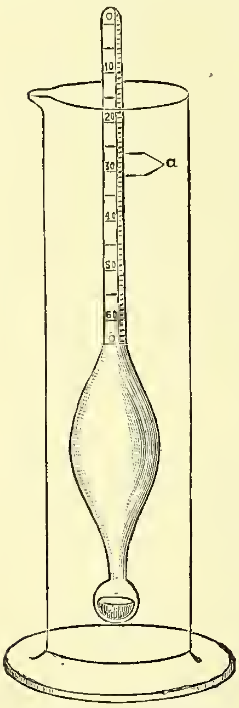


FIGURE 110. — (After HASSALL.)—A lactometer, and glass vessel for holding milk to be tested. The points on the scale indicated by *a* are the limits of specific gravity of healthy, pure milk.

Milk from cows fed chiefly on distillery swill, and that from diseased cows, though not known to contain the germs of any particular malady, may be regarded as by far less nutritious and more readily undergoing an acid change, than milk from healthy, well-fed cows.

The addition of foul water to milk, or the cleansing of cans with water in which there is sewage contamination, should be carefully avoided, as many cases of typhoid fever have been known to occur in consequence of washing milk-cans with water which had previously been so contaminated.

The quality of milk is easily tested by its specific gravity and by the proportion of cream which it contains. The specific gravity of milk usually ranges from 1030° to 1034°, that of water being 1000°. When a specific gravity instrument is made to be exclusively used for the examination of milk, it is called a *Lactometer*, and its scale is graduated from 0—which is equivalent to 1000 on a hydrometer scale to 100—which represents the standard of pure milk; the latter point, however, is somewhat arbitrary with the maker of the instrument, some placing 100 so as to correspond with 1034 of the hydrometer, and others placing it below that standard. As pure milk varies somewhat in its specific gravity, the purchaser of a lactometer should always know the standard adopted in order to

more accurately determine the quality of the milk he proposes to examine. The standard established by the Health Department of New York is 1,029, and in graduating the lactometer used by the milk inspectors, 100 is placed at that standard, which is one below the usual minimum. This low standard was adopted that the milk dealers might have no cause to complain of unfair treatment at the hands of the inspectors. In testing milk for its specific gravity, a sufficient quantity of the fluid is poured into a deep glass vessel (a wide-mouthed bottle will answer), and the instrument carefully immersed. If it is sustained to the point 100 we are assured that the milk is undiluted, but if it sinks to 90 we know that the fluid consists of 90 per cent. milk and 10 per cent. water.

The test for cream by the creamometer is not so reliable, as the amount of cream rising to the surface does not always indicate the amount of fat present. The instrument is a glass tube, eleven inches long and half an inch in diameter, graduated from 0 to 100,

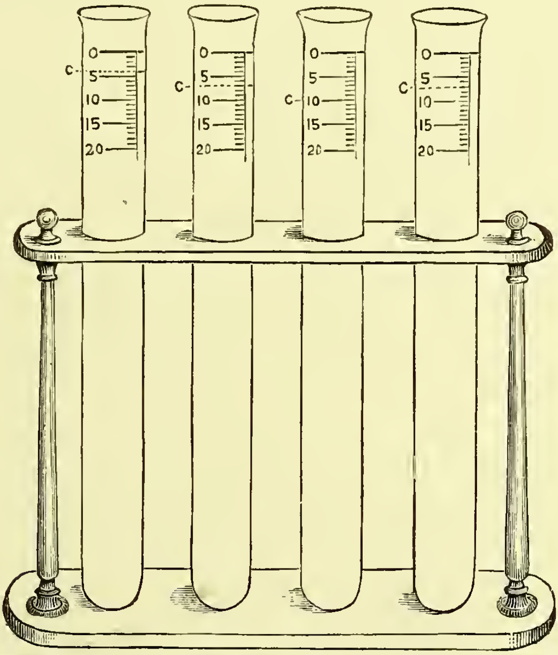


FIGURE 111.—(After HASSALL.)—Four creamometers arranged in a stand. Each having been filled to the zero mark with milk from a separate cow, the letters C indicate the depth to which cream had risen in each tube at the end of several hours, namely: in the one to the left, four per cent., in the next seven per cent., in the third, ten per cent., and in the one on the right, seven per cent.

the 100 mark being at the bottom of the tube. To test milk for the amount of cream it contains, the tube is to be filled to the 0-mark and allowed to stand for twenty hours, when the percentage of

cream may be readily seen on the graduated surface of the tube. Some samples have shown as high as eighty per cent. of cream, but ordinarily good milk tested in this manner should show from twelve to sixteen per cent. [eleven and a half per cent., according to Hassall] ; but this is only an approximation, and to arrive at any accurate knowledge a chemical analysis is necessary.*

Butter.

Butter is fat separated from cream by the process of churning (by which operation the albuminoid vesicle, or envelope of each globule of fat, is broken ; the fat escapes and is collected into a mass). When fresh and sweet it is an excellent heat-giving food, well tolerated by stomachs that cannot bear fat meat, and with food abounding in starch it seems almost indispensable, as we know by the relish it lends to bread and potatoes. It frequently contains some casein, which, acting as a ferment, causes the butter to become rancid. In order to prevent this, care should be taken to expel, as completely as possible, the buttermilk which contains the casein, by thoroughly working and kneading the butter, which, when free from casein, will remain fresh and sweet for a long time. It is estimated that one cow will produce 140 pounds of butter per annum, the average yield being about one pound to twelve quarts of milk.

Quite recently an artificial butter, known as *oleomargarine*, has been introduced, made chiefly from beef-suet. The method of manufacture is to take the fresh suet, carefully washed and cut very fine, and submit it to a heat of about 120° Fahr., which separates the fat from the cellular tissue. The liquid fat is then drawn off from the tank and allowed to cool until it solidifies, when it is

---

* "Pure milk, not deprived of its cream, has a less specific density than skim-milk, caused by the lightness of the cream. If the cream be wholly or in part removed from milk, the residual fluid will weigh heavier than that which contains its normal proportion of cream. Skim milk, therefore, tried by the galactometer scale for pure milk only, would give a higher specific gravity than ordinarily belongs to pure milk, and hence the error might be committed of supposing it to be pure—an error which can be corrected by means of the creamometer, whereby the percentage of cream is estimated. . . . . Again, if to such skim milk we add a certain percentage of water, we restore it to its proper specific gravity, and therefore this milk would show . . . . the density proper to pure milk, and hence this fraud would escape detection. In order to meet cases of this kind, which are of frequent occurrence—namely, the complete or partial removal of the cream—it is necessary also to employ the creamometer, and ascertain by it whether the sample contains the proper proportion of cream or not. Indeed, it is not possible to come to any certain or safe conclusion without employing the two instruments, the lactometer or hydrometer, for taking the specific gravity of the whole milk, and the creamometer to measure the cream."—HASSALL on "Food: Its Adulterations and the Methods for their Detection."

submitted to pressure, which separates the oily portion from the stearine. This oil, which is known as oleomargarine, is now churned with about half its volume of new milk, producing what is called oleomargarine butter. As this is produced at a much less expense than ordinary butter from the cow, and as it is more palatable than most of the cheap butter in the market, and possesses the advantage of not becoming rancid, it is rapidly gaining ground as an important article of trade, large quantities of it being exported, besides being used here to a considerable extent by those who, from necessity or choice, are induced to practise economy in the purchase of their food supplies.

Cheese.

Cheese is the coagulated casein which, after its separation from the milk, has been pressed and dried. When made of unskimmed milk it contains also the fat, and is therefore both plastic and respiratory, or flesh-forming and heat-forming. It may, therefore, be eaten to some extent as a substitute for meat; but it should be remembered that cheese is a highly concentrated food, and cannot be digested in large quantities at a time, and therefore it should always be eaten somewhat sparingly, and with substances more bulky and containing plenty of starch and fat. Thus, bread and butter and cheese, with a moderate allowance of potatoes, will constitute a fair diet for a time in the absence of meat. Cheese that is made of skimmed milk consists principally of casein, and is therefore a nitrogenous food in a still more concentrated form, and if eaten alone is less easily digested than cheese made from unskimmed milk. To secure its digestion it should be eaten with a still larger proportion of bread, vegetables, and fats.* The digestibility of cheese depends partly upon its age, and partly upon the amount of fat it contains; new cheese and skim cheese, being masticated with difficulty, are prematurely swallowed, and hence require a longer time for digestion than old cheese, or cheese containing a proper proportion of fat. Cheese abounding in fat is known as rich cheese, while skim-milk cheese is called poor; and although the latter is richer in plastic material than the former, it

* [Large quantities of cheese are made and sold, in this country and in Europe, in which oleomargarine has been mixed with skimmed milk to replace the cream. After the mixture the milk is thoroughly stirred, rennet is added in the usual way, and the fat is contained in the curd in the same way that the cream would have been if it had remained. Although it is not equal in quality to good cheese from unskimmed milk, it is better, as a food, than the skimmed milk variety.—ED.]

is doubtful if it affords any greater amount of nutrition, because it is less easily digested.

Edward Smith gives the following as the proximate composition of each of the two varieties of cheese :

Skim-milk cheese.	Water, 44 ;	Nitrogenous, 44.8 ;	Fat, 6.3 ;	Salt, 4.9.
Very good new milk cheese......	" 36 ;	" 28.4 ;	" 31.1 ;	" 4.5.

Eggs.

Eggs are both nitrogenous and carbonaceous, the nitrogenous element being furnished by the white in the form of albumen, while the yolk also furnishes albumen, oil, and a small amount of sulphur. As they contain no starch or sugar, and but little fat, they do not constitute a complete diet, but should be eaten with articles which supply these elements ; hence, ham and eggs, with potatoes, bread and butter, not only gratify the taste, but supply the natural wants of the system. Eggs enter largely into the preparation of various dishes, as cakes, puddings, custards, creams, etc., and in this way contribute to our enjoyment as well as to our necessities. When quite fresh, they are more palatable and more easily digested if boiled or poached than if fried ; but any slight musty taste which they may have acquired by time is destroyed by the greater heat to which they are exposed in frying. They should be cooked until the white is coagulated, without hardening the yolk ; but, if cooked beyond this point, the time required for their digestion is increased.

Eggs contain about twenty-six per cent. of solid matter, of which fourteen per cent. is nitrogenous or flesh-forming, and ten and a half per cent. carbonaceous or heat-forming.

Meat.

Meat, as human food, is used more or less extensively in all parts of the world, and is regarded by all civilized nations as the best promoter of strength and activity, both of muscle and brain. Dr. Letheby says that in London "the indoor operatives eat it to the extent of 14.8 ounces per adult, weekly ; seventy per cent. of English farm-laborers consume it to the extent of sixteen ounces per man, weekly ; sixty per cent. of the Scotch, thirty of the Welsh, and twenty of the Irish, also eat it." In this country it is eaten in larger quantities, and by a much larger proportion of the people, few being so poor that they cannot afford it in some form.

Although the meats of different animals vary in regard to cer-

tain peculiarities, they are nevertheless essentially the same, being rich in nitrogenous matter and fat, containing also a considerable amount of salts, and, in short, highly nutritious and easily digested and assimilated.*

In flavor, meats vary with the different modes of cooking, with the age of the animals, the manner in which they are fattened, and the way in which they are preserved. Salting meat detracts from the flavor and nutritious quality by extracting a portion of the juices, leaving the lean portion tough and difficult of digestion, and with a flavor much inferior to that of fresh meat. In cooking meat it is important that the juices be saved, and this is effected by first exposing it to a high temperature for a few moments, by which the albumen on the surface is coagulated, forming an impervious coating which prevents any further escape of fluid. The temperature may then be somewhat reduced and the process continued, the meat being cooked in its own fluids, and when done it is tender and juicy. If, however, the opposite course be followed, and the meat first exposed to a low and gradually increasing temperature, the result will be quite different, as much of the fluid and nutritive portion of the meat will escape, leaving the remainder comparatively dry, hard, and indigestible. The latter course is to be adopted only in making soups or broths, when it is desirable, as far as possible, to extract the juices and nutritive qualities from the meat in order that the soup may be good ; and it is well known that we cannot have both good soup and good meat from the same piece.

Of the different methods of cooking meats, doubtless roasting develops a flavor which is most agreeable to the greatest number of persons, while perhaps the most economical method is stewing, in which there is no waste. Certain meats, however, seem to require certain methods of treatment in order that their best flavors may be fully brought out, and they be rendered tender and digestible ; and it may be added, that, to effect this purpose, meat should be kept some time after the animal is slaughtered. It is said that the nearer meat approaches a state of incipient decomposition, without becoming in any degree tainted, the more agreeable its flavor and the more tender and digestible it becomes.

Beef, from its close texture, its large proportion of lean meat, the amount and richness of its juices, and its agreeable flavor when properly cooked, has well been regarded, in point of nutritive value, as the leading article among animal foods. The proportions of lean and fat meat in the average carcass are such as to meet

---

* It is a notable fact that, with very rare exceptions, the flesh of *carnivorous*, or meat-eating animals and birds, is never used as human food.

the general wants of the system, as it regards animal food, while the accompanying vegetables, with the bread and butter used, contribute to the completion of a perfect diet. When properly cooked, it is not only grateful to a majority of palates, but is readily digested and assimilated, affording to the system good muscular development, with a plenty of heat and force-giving material. It is more nutritious and more easily digested when fresh than when preserved with salt, as this process extracts a portion of the juices, and renders the meat comparatively hard and dry. Hence, corned beef, though a favorite with some, is more difficult of digestion and less nutritious than fresh beef.

Veal, though of a delicate flavor, is of less nutritive value than beef. It varies much according to the age of the animal, which may be anywhere from one month to six or nine. A calf, well fattened on its mother's milk, and killed at the age of five or six weeks, yields meat which is very tender and of a delicate flavor, but not so easily digested as beef; neither can it be used as a daily food, because it is not sufficiently nutritious to meet the requirements of active life. When roasted and thoroughly cooked it makes a delightful dish for occasional use.

Mutton ranks next to beef in point of nutritive value, and as an agreeable food for all classes of persons. It has a delicate flavor, and is a favorite meat at the English table. It contains more fat than beef, and is of a somewhat looser texture, and therefore does not impart the same muscular strength and powers of endurance that are derived by those who partake of an equal quantity of well-cooked beef. It is a wholesome, easily digested meat, and well adapted to the wants of persons whose occupations do not call forth strong physical exertion, or whose support does not depend upon continued muscular effort. It may be cooked by roasting, boiling, or stewing, and, we may add, to some extent, by frying. Mutton chops, cooked in the latter style, are regarded by many as a superior dish. The joint which is sometimes cooked by boiling is the leg, as it contains less fat and bone in proportion to the amount of meat than any other part of the animal.

The term "braxy mutton" is applied to the meat of a sheep that has died of disease of some vital organ, as the brain, lungs, etc., the illness being of a brief duration, and the animal dying, as is supposed, before the flesh has become infected with disease. It is said that among the Scotch shepherds a considerable use is made of braxy mutton, and that one feature of the contract between the farmer and his shepherd is that the latter shall be entitled to a certain number of braxy sheep yearly. As to the effects of eating meat of this kind, Edward Smith says he has made the most care-

ful inquiries without being able to learn that any disease of the human system had been known to follow the use of it, and that it is generally believed to be good in flavor and wholesome in quality. It is the practice to salt the meat for the purpose of preserving it, and any portion having the appearance of being unsound is cut away. In this country the meat of no animal that has died in any other way than being slaughtered for human food is used as such, the laws of many of the States being very strict on this subject.

Lamb has a somewhat more delicate flavor, and is more readily digested than mutton, being tender, and the flesh less solid than that of the full-grown sheep, containing more water and less nitrogenous matter. It is therefore regarded more as a luxury than a solid and strengthening food.

Goat's and *kid's* flesh are eaten in some countries to considerable extent. In flavor they somewhat resemble mutton and lamb, but they contain less fat and more nitrogenous matter, and are therefore regarded as stronger foods.

Pork contains by far more fat and less nitrogenous matter than beef or mutton, and is of less value as a flesh-forming and strengthening food. The habits of the animal, and the manner in which it is kept and fed, favor the storing up of fat; and its rapid growth, with the comparatively short time required for fattening, renders the meat very much cheaper than beef, and hence it is much used by the poor. In this country it is used more generally in the agricultural districts than in cities, as it is preserved by being packed with salt, and is always at hand when fresh meat cannot be obtained. Some portions of the animal, as the belly and face, contain so much fat that when fresh the meat is not easily digested, and is not eaten until after it has been salted. The most delicate part of fresh pork is the tenderloin, and the most substantial portion, when properly cured, is the ham, as it contains less fat and more nitrogenous matter than any other part of the animal.

As pork is more frequently diseased than other meat, and as the diseases are such as to seriously affect the human system, it follows that pork is eaten with greater risk than attends the use of most other meats.

The *cysticercus*, or *measle*, in pork, consists of a parasite armed with a crown of hooks and enclosed in a sac, the whole being about the size of a hemp-seed. These parasites are diffused through the lean part of the meat, and, when swallowed, the creature is soon liberated from its sac by the action of the gastric juice, when it passes into the intestines, where it fastens itself by its hooks, and, by growing, soon develops into a tape-worm. When once introduced into the human stomach it is sure to add to itself joint

after joint, until its effects are fully realized. [For further description, see also affections of digestive apparatus in infancy and childhood.]

Another encysted parasite which infests pork is the *trichina spiralis,* a minute thread-like worm, about the thirtieth of an inch

FIG. 112.

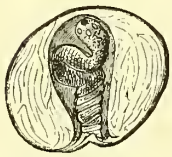


FIG. 113.

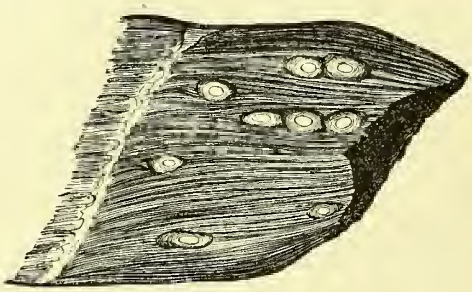


FIG. 114.

FIGURE 112.—Cysticercus cellulosæ, natural size.
FIGURE 113.—The same seen through a magnifying-glass.
FIGURE 114.—A fragment of pork containing the cysticercus, which, on passing into the stomach and being digested, liberates the parasites. These attach themselves to the walls of the intestine and develop into tape-worms (*Tænia solium*).

in length, and, as its name indicates, coiled up in a spiral form. It exists in the lean meat, and, like the measle, when taken into the human stomach, it is soon released from the cyst, and by the nourishment it receives it grows rapidly and begins to multiply its species, the female producing from 300 to 500 young. These young worms soon make their way through the intestinal coats, and penetrate to the muscles in different parts of the system, where they eventually find lodgement, causing, in their travels, severe irritation of the stomach and intestines, with high fever and excruciating pain in the inflamed muscles along which they burrow. The disease progresses until the patient dies, or nature brings relief by surrounding each worm with a fibrous sac, after which it is harmless. Many cases of this disease have occurred from the eating of pork, a large proportion terminating fatally after brief periods of intense suffering. [For further description, see chapter above referred to.]

As this parasite is not easily detected with the naked eye, it should be the invariable practice of all pork-eaters to see that their meat is thoroughly cooked, as the heat required to cook the meat through to every part is alone capable of destroying the trichina; and as the microscope is not in the hands of every cook, we can never be certain that our meat is absolutely free from disease. Most of the cases of trichinosis of which we have any account have resulted from eating pork imperfectly cooked, or uncooked sausages, or ham infested with the worm, which imperfect cooking failed to destroy.

The meats thus far occupying our attention comprise the ordinary flesh foods in use, though various other animals contribute from time to time to the sustenance of the human family, and may now be briefly noticed.

Game.—Without entering into minute inquiries concerning the nutritive value of different varieties of game, it may suffice to say that, as a rule, animals that run wild have a greater proportion of solid flesh and less fat than domestic animals, and hence contain more nitrogenous matter. The flesh is also more solid, and masticated with greater difficulty. The flavor is generally somewhat stronger, and the meat, if well digested, is highly nutritious.

Poultry and small game are used to a considerable extent in some seasons of the year. The meats are easily digested, are less juicy, and contain less fat than butcher's meat, and they are better adapted to the wants of the sick and invalids than of strong working men. In this class of meats we have a great variety of quality and flavor, and, as a rule, we may say that the dark meat of a fowl is more easily digested than the white.

Fish, of which there is an almost infinite variety in use throughout all parts of the world, although palatable and digestible, cannot, in point of nutritive value, be wholly substituted for the flesh of animals, as most of the varieties are too deficient in nitrogenous and fatty matter to meet the wants of the working classes. The value of this kind of food varies much with the kind of fish—the red-blooded class, of which the salmon is a good representative, being more nutritious than the white. The amount of fat also varies, the salmon having a good supply distributed through the flesh, while in the cod it is stored up in the liver. The varieties of fish which are rich in fat are the salmon, the trout, the mackerel, and the eel. The meat of white-blooded fish is deficient in fat, and hence requires to be eaten with substances which supply this deficiency. Thus, we see that the melted butter which is invariably served with certain kinds of fish is not only an agreeable accompaniment, but a necessity. Although fish is generally poorer in nitrogen and fat than butcher's meat, it is richer in many important salts, and, when eaten occasionally, is an important article of diet, while persons who live exclusively on fish are said to suffer from scurvy, as they are generally badly nourished. Fish should be eaten when perfectly fresh, as they rapidly undergo decomposition, when they often become poisonous and cause serious illness.

Shell-fish are generally considered as luxuries rather than necessary food. Of these the most easily digested is the oyster, eaten raw or roasted. Clams, crabs, and lobsters are digested with more difficulty, though they are very extensively used when in season.

VEGETABLE FOODS.

These include the seeds, fruit, roots, and in some cases the leaves and stalks of plants. As has already been stated, vegetables contain both nitrogenous and non-nitrogenous elements, but the former are not in proportion to afford a healthy nutrition for an indefinite period without overtaxing the digestive organs with a surplus of non-nitrogenous matter, and hence persons attempting to live on vegetables alone become large eaters, and thus acquire large abdomens.*

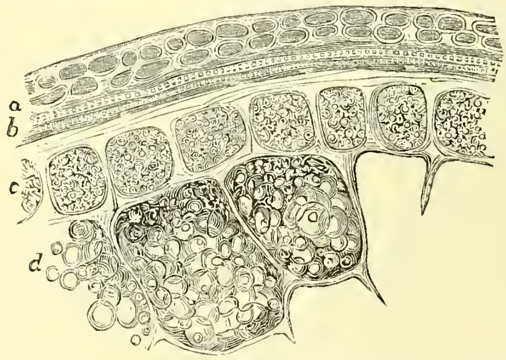


FIGURE 115.—(After HASSALL.)—Structure of a grain of wheat magnified; *a*, *b*, the layers of the testa or outer coat; *c*, the layer containing gluten and mineral salts; *d*, the internal structure composed of compartments or cells holding starch-grains. (Largely magnified.)

Among the *seeds* used for food we have the cereal grains, the most important of which is wheat, as it contains nearly all the elements of nutrition, is produced abundantly in all parts of the civilized world, and is easily prepared for use.

Wheat contains from ten to fifteen per cent. of gluten, and from sixty to seventy of starch. It also contains alkaline and earthy phosphates, and small proportions of water and fat. In order to secure the full amount of nutrition afforded by wheat, it is necessary that the entire part of the seed within the extreme outer coat be saved in the process of flour-making. The wheat kernel consists of three distinct parts, the central or starchy portion, of which the white flour is made; surrounding this is a layer

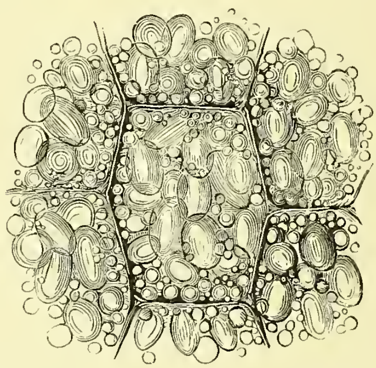


FIGURE 116.—(After FIGUIER.)—Starch-grains of wheat contained in the woody cells of the seed. (Largely magnified.)

* [Professor Gubler, of Paris, has recently made some researches into the causes of a disease of the blood-vessels, in which their coats become calcified, or chalky, and, instead of retaining their elasticity, become rigid like pipe-stems. The result of his inquiry shows that the principal cause of this trouble lies in a vegetable diet. French peasants are very liable to the disease, and the Trappist order of monks, who live exclusively on vegetable food, very soon show this degeneration of the coats of their arteries.—ED.]

which contains the gluten and phosphates, a good deal of which is rejected with the bran in the manufacture of fine flour ; and surrounding all is a very thin, siliceous, and woody husk, the office of which is to contain and protect the other two portions of the grain, but in itself it has no nutritive value. If we desire the starchy portion only, we bolt the meal very finely and obtain nothing but the whitest flour ; but, if, on the other hand, we wish to obtain the glutinous portion separately, we submit the bran to a second and coarser bolting. In grinding wheat, the miller passes it through a series of bolting-cloths, and thus obtains his different grades of flour, the finest being the best in appearance and of the most delicate flavor, consisting principally of starch, while the coarser grades contain more flesh-forming material.

Rye ranks next to wheat in nutritive value, but it makes a darker flour, and the bread made from it is inferior in flavor and digestibility to wheaten bread, as well as less nutritious. In 100 parts of rye meal there are, of water, 15 ; nitrogenous matter, 8 ; starch, 69.5 ; sugar, 3.7 ; fat, 2 ; salts, 1.8.

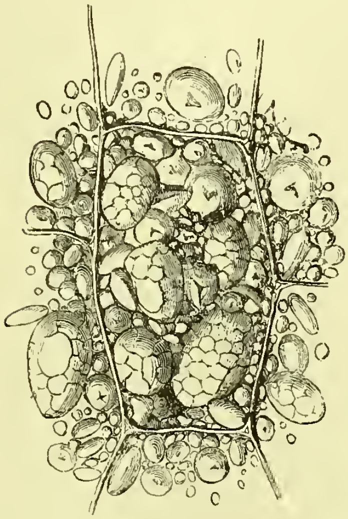


Fig. 117.

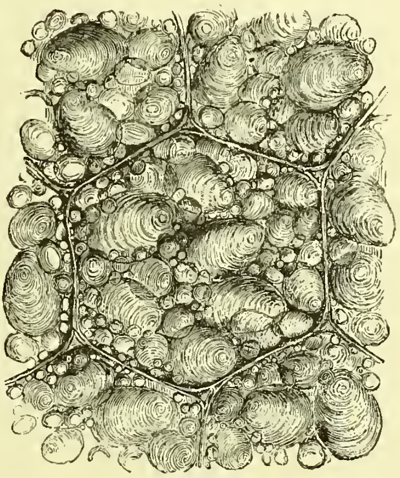


Fig. 118.

Figure 117.—(After Figuier.)—Starch-grains of Indian corn, magnified.
Figure 118.—(After Figuier.)—Starch-grains of the potato, magnified.

Buckwheat is rich in starch, but not in gluten ; and owing to this latter deficiency, it does not make light bread. Buckwheat cakes, which are common with us during the winter season, when well made, are light, and exceedingly agreeable ; and with the butter and syrup, which usually accompany them, furnish a good supply of heat-forming material.

Indian corn is raised abundantly in many parts of the world, especially in warm countries. In 100 parts of the ripe grain, there are, of water, 14; nitrogenous matter, 11; starch, 64.7; sugar, 0.4; fat, 8.1; salts. 1.7. When eaten green, it has a very agreeable flavor, and is to most people a wholesome food; but it does not agree well with all stomachs. As the nitrogenous matter in corn is not of a glutinous nature, it does not make a light bread, but is excellent for hot cakes and puddings. As the flavor of corn meal is harsher than that of wheat and rye, it should be improved by mixing with it milk, eggs, and sugar; and when well prepared in this way and thoroughly cooked, few preparations of the kind are more agreeable and wholesome than hot corn-bread, Indian pudding, or "hasty pudding," immortalized in song.*

Corn-starch is used pretty extensively in puddings, etc., and is quite equal to farina or arrow root.

Oatmeal is nutritious and digestible. In 100 parts there are, of water, 15; nitrogenous matter, 12.6; starch, 58.4; sugar, 5.4; fat, 5.6; salts, 3. Like corn-meal, it does not make a light bread, but is generally prepared by boiling with water or milk, and is eaten with milk, or with butter and syrup or sugar. It is a strong and healthy food when thoroughly cooked; but as the flavor is somewhat harsh, a liking for it is oftener acquired than natural.

Rice is a very digestible, though not a strong food, as it contains much less nitrogenous matter than any other of the cereal grains. The average proximate elements in 100 parts of rice are—water, 13; nitrogenous matter, 6.3; starch, 79.1; sugar, 0.4; fat, 0.7; salts, 0.5. We see from this that as a plastic food it has less than half the nutritive value of oatmeal, being only half as rich in nitrogenous matter, and containing a much less relative proportion of salts. It is also very poor in sugar and fat, but contains less water than other grains, is the richest of them all in starch, and constitutes the chief diet of more than one-tenth of the entire population of the globe. Unlike other grains, when harvested and ready for market, it has no waste material, as the outer siliceous coat is removed in the cleaning-mill, leaving nothing but the clean white grain, of which there are different grades, the broken and smaller grains being separated from the larger, which constitute what is known as prime. This latter quality has a higher commercial value than the broken grains, though not more nutritious. The broken grains are sometimes ground and mixed with wheaten flour for the purpose of adding to the whiteness of bread—an adulteration (if it may be so called) which is not injurious, neither does it

* "Hasty Pudding," a poem, by Joel Barlow, about the year 1793.

materially affect the pecuniary interest of the baker any further than perhaps to secure a more ready sale for his product.

Where rice is used as a staple article of food, it is boiled in water until the kernels are soft. It should then be eaten with fat and lean meat. It may be used for a limited time as a substitute for potatoes ; but its deficiency in salts renders it inferior to the potato. When used solely as an article of food, it requires large quantities to furnish the proper amount of plastic material ; and hence the people of rice-eating nations acquire large abdomens, and are generally noted for inferior development both of body and mind. In this country rice is used more as a luxury, and, when cooked with milk and eggs, it is not only more palatable, but forms a more substantial diet than when eaten alone.

Barley, in the preparation of solid food, is used but little in this country. It is, however, an important article in the diet of the Welsh, Scotch, and English peasantry. In 100 parts of barley-meal, there are of water, 15 ; nitrogenous matter, 6.3 ; starch, 69.4 ; sugar, 4.9 ; fat, 2.4 ; salts, 2.0. The nitrogenous matter in barley is of an albuminous rather than a glutinous nature, and hence barley-meal cannot be made into a light dough except when mixed with wheat or rye-flour. Barley is chiefly used in this country by the brewer ; but, when used as food, it is generally with soup, or in the form of gruel for the sick. As a nutritious food it is superior to rice in that it is richer in sugar, fat, and salts.

Beans and *peas* are rich in nitrogenous matter, containing from twenty-three to twenty-five per cent.* They contain only about two per cent. of fat, but they are rich in starch and important salts, and hence constitute a somewhat concentrated food, and should not be eaten in large quantities, except by persons who are accustomed to a good deal of active exercise. Being deficient in fat, the custom of baking with our beans a piece of fat pork not only renders them more palatable, but by the aid of a moderate quantity of fat they are more easily digested. A sausage made of pea-meal and bacon fat, with the appropriate condiments, was an important article of diet furnished the German soldiers during the war with France, in 1870. In this preparation they had a large amount of nutriment in a compact form, of which they could make their pea-soup, adding whatever they could obtain to increase the bulk and complete the diet.

The Potato, as a substantial article of food, stands at the head of esculent roots. It contains, in 100 parts : water, 75 ; nitrogenous

* The nitrogenous matter of peas closely resembles casein in its properties. This fact is taken advantage of in China, where a kind of cheese is made from this source.

matter, 2.1; starch, 18.8; sugar, 3.2; fat, 0.2; salts, 0.7. Having but a small percentage of nitrogenous and fatty matters, it is not a food which alone meets the entire wants of the system, and hence it should be eaten with meat and fat. As a vegetable, however, it is invaluable, and is probably used more extensively than any other one article (unless it be rice, which is so largely an article of food in oriental countries). In boiling, it loses a portion of its salts, which are dissolved in the water, particularly if the water be soft, or if the skin be removed before boiling. By boiling it in hard water, or without first removing the skin, or by baking or roasting, the loss of these valuable salts is prevented. The potato, like all succulent vegetables (which contain a large proportion of mineral salts), has the power of preventing scurvy, and is therefore of great importance to persons who are compelled to live largely upon salted meats. Hence their great value in the army and navy, and on shipboard.

Other succulent vegetables, as the turnip, parsnip, carrot, beet, onion, squash, etc., though containing less solid matter than the potato, are nevertheless of value, as all of them contain salts, sugar, starch, and nitrogenous matter in varying proportions. They are also of use in affording bulk, or, in other words, in diluting the more concentrated varieties of food, and thus aid in promoting digestion.

Among the leaves of plants used for food, the cabbage and its kind may be regarded as the more important. They all have antiscorbutic powers as well as considerable nutritive matter. Young shoots of vegetables, in the spring season, are healthy and valuable for their salts in combination with vegetable juices. Among the large number of these in common use are the dandelion, spinach, beet-tops, young cabbage, and turnip-tops, and various other young sprouts, unnecessary to mention in detail, but all useful in supplying certain elements which help to make up the perfect diet.

Fruits are generally regarded as luxuries rather than necessary or nutritious foods, as they contain but little nitrogenous matter; but many of them being rich in sugar, and containing important salts in a form to be most readily taken up by the absorbents, we must regard them as valuable not only in sharpening the appetite, but in furnishing the system with many essential elements of nutrition. Without attempting to enumerate in detail the various kinds in use, it is proper to say that a moderate indulgence in fruit-eating is at all times both agreeable and wholesome.

Mushrooms.—The edible mushroom is generally regarded as highly nutritious, and yet the question as to what varieties may be eaten with safety, and what are poisonous, still remains unset-

tled.* In France the mushroom in nearly all of its varieties is highly valued as food, and is extensively cultivated for that purpose; while in our own country we sometimes hear of cases of poisoning from the use of some of its varieties. It is a fungus of an umbrella-shaped top found in cellars and other excavations, also in pastures and meadows when the atmosphere is moist and the ground is excluded from the bright sunlight. The roots consist of an entangled thread-like mass called mycelium or spawn, which, when planted in a loamy soil enriched with stable manure, rapidly develop the crown of the fungus. The average proportion of water in the mushroom is about ninety per cent., and of the dried mushroom from three to seven per cent. is nitrogen. They are eaten raw or fried with butter and condiments, and are also used in the preparation of catsup and sauces.

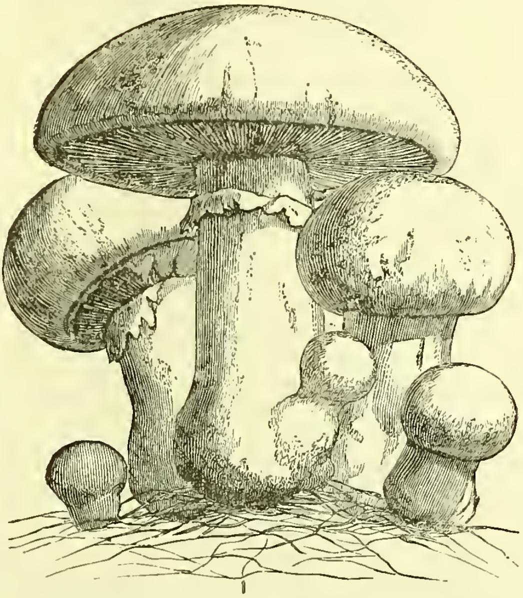


FIGURE 119.—Edible mushrooms (*Agaricus Campestris*).

The truffle is a fungus of which there are different varieties; that of the genus *Tuber* being the most common, though others are used. As truffles are somewhat rare, and are much sought for by epicures and fashionable people on account of their aromatic and agreeable flavor, their money value is far out of proportion to their nutritive qualities.

CONDIMENTS.

Condiments are mostly regarded as supplementary to foods rather than as real, and are used either for the purpose of preserving food or of rendering it more palatable. In the former office *common salt* figures more extensively than any other article; but, as it has already been shown that this is an essential article of diet, it will

* For description of the best-known means for distinguishing the edible from the poisonous varieties, see chapter on poisons.

now be mentioned only as an important condiment in the preservation of meats.

Vinegar is also largely used as a preservative and to give relish to certain foods. It is produced by acetous fermentation of a saccharine material, and its properties and uses are now too well known to need any further description here.

The other condiments, as the spices, the peppers, the aromatic roots, mustard, etc., are used to improve the flavor of food, which they do, besides having the effect of stimulating the flagging appetite, and strengthening and improving the digestive function. They must, therefore, be regarded as important adjuncts to our food supplies.

BEVERAGES.

The beverages in general use at the table in this country are tea, coffee, and cocoa. Each one has its proportion of nitrogenous matter, fat, sugar, salts, etc.—and therefore they may be considered in some degree as foods.

FIGURE 120.—Flowering stem of the tea-plant—*Camellia Thea.*

Tea is used more extensively than either of the other articles, and has the effect to stimulate the nervous system without producing any subsequent depression. It is therefore refreshing to the weary; it revives the exhausted, and, for the time being, it is food to the hungry. Tea is valued principally for three properties — first, its active principle, known as *theine,* rich in nitrogen, and contained in proportions varying from one and a half to five, or even six per cent.; second, tannic acid, upon which the astringent quality of tea depends, from thirteen to eighteen per cent. ; and third, a volatile oil which gives to tea its agreeable flavor, and is contained in the proportion

of about one part in 150. Besides these, tea leaves contain about twenty per cent. of gluten, which, of course, is not extracted in preparing the beverage.

Green and black teas are sometimes prepared from the same plant, the difference in flavor, as well as in color, being the result of the manner in which the leaf is treated, the process of roasting, rolling, and drying being more rapidly conducted in producing the former than the latter.*

It requires the temperature of boiling water to extract the active principles and flavor of tea; but if the boiling be continued, the volatile oil on which the flavor depends is dissipated, leaving a bitter and astringent taste which is far less agreeable. Hence, in order to obtain a beverage in which all of the qualities are preserved, we should pour boiling water on the leaves, and allow them to steep for a while in a tightly-covered vessel, with the temperature slightly reduced.†

The effects of strong tea are not always favorable to digestion, especially with those whose digestive powers are feeble, as the action of tannic acid is to coagulate the albumen of animal food,

---

* The varieties of tea are very numerous, but the best known are probably those enumerated by Redwood, who quotes Des Guignes:

Green Teas.—1. *Songlo* (from the place where it grows); has a leaden cast; the infusion is green; the leaves are longer and more pointed than the black teas; the inferior sorts have yellow leaves and the smell of sprats. 2. *Hyson tea* (*he tchuni*, or first crop); is of a leaden cast; the infusion is a fine green; the leaves are handsome, without spots and open quite flat; it has a strong taste, and a slight smell of roasted chestnuts. 3. *Tcheu tcha.* 4. *Hyson skin*, or *bloom tea*, being the large, loose leaves of the hyson; a faint, delicate smell; infusion a pale green; the bloom is given by indigo heated under it. 5. *Superior hyson skin*, intermediate between hyson and hyson skin. 6. *Gunpowder tea*, a superior hyson in small, round grains, of a blooming, greenish hue. 7. *Chelian*, or *cowslip hyson*, a scented hyson mixed with small berries, that give it a cowslip flavor.

Black Teas.—1. *Bohea* (*Vo he*, the name of a place); is of a black cast, and yields a deep yellowish infusion. 2. *Congou* (*cong fou*, great care); the infusion is lighter than that of bohea, rather green, and seldom of an agreeable smell. Preferred by the Chinese for their own use. 3. *Soutchong* (*se ow chong*, a very little sort); the infusion is a fine green, smells agreeably; the leaves ought to have no spots on them. 4. *Pekao* (*pe kow*, white leaf-bud); the infusion is light and rather green, has a violet scent, and a very fine perfume in the mouth. 5. *Imperial* (*mao tcha*); has a green cast; the infusion is also green; the leaves large and of a fine green; has a slight smell of soap. To these may be added *Campoi*, which is intermediate between congou and soutchong. 6. *Padre* (*pou chong tcha*); a very fine soutchong, imported in pound papers, for presents, being the best and most delicious. 7. *Caper;* made into balls with gum and scented, imported only in small boxes.

† The use of water, rendered slightly alkaline with soda or potash, favors the complete extraction of the active properties of tea-leaves. In some parts of Russia and Tartary, where tea is the universal beverage, the natural alkaline waters used in its preparation are thought to add very considerably to its flavor.

as well as to interfere with the already diminished secretion of the gastric fluids ; and, hence, tea that is taken at meal time should be of moderate strength and moderate in quantity.*

Coffee has a similar composition to that of tea ; containing an alkaloid known as *caffeine*, which is its active principle and identical with theine ; tannic acid in a less proportion than is contained in tea ; and a volatile oil developed by the action of heat during the process of roasting the seed, and upon which the agreeable flavor of the coffee depends. It also contains sugar, gum, and gluten, besides a considerable amount of saline matter. Of these, the caffeine, tannic acid, volatile oil and salts only, are extracted during the preparation of coffee for the table. Like tea, coffee is a gentle stimulant to the nervous system ; it induces wakefulness, quickens the intellect, promotes digestion and assimilation of food, invigorates the body, and thus increases the powers of physical and mental endurance.

The use of tea and coffee is said to retard the waste of animal tissue, and thus it enables a person to live upon a smaller allowance of food than is required by one who drinks water only. This doctrine has been pretty generally taught and believed, not only from the fact that tea and coffee drinkers work better and accomplish more than others while eating less, but also, from experiments of Lehmann in 1854, showing that after the use of coffee there was a less amount of urea and phosphoric acid excreted by the kidneys than when the food was taken without tea or coffee. On the other hand, the experiments of Edward Smith, with both tea and coffee, led him to regard them as respiratory excitants, from the fact that after their use respiration was increased, as was also the amount of carbonic acid evolved, from which he argues that there must be an increase of animal waste in proportion to the increased amount of carbonic acid. Notwithstanding these experiments, we have the daily experience of many, who have carefully watched the effects of tea and coffee upon themselves, that, when using them, they are capable of accomplishing more on the same amount of food than when these beverages are not used, the nutritive action of the food being increased, or digestion and assimilation being more fully performed.

As coffee is more frequently adulterated than tea, our best security is to purchase the whole seed and prepare it ourselves. The operation of roasting should be carried just far enough to fully develop the aroma, but not far enough to allow any portion

* When taken in large doses tea produces watchfulness, nervous agitation, and is even emetic ; this irritability is said to be best allayed by drinking buttermilk.

to become in the slightest degree charred, as that would destroy the flavor of the best coffee. The seeds should be first dried in an open vessel over a moderate fire, until the water is evaporated and a yellowish tinge is produced, when they should be tightly covered and the process continued over a good fire until the seeds acquire a deep chestnut color and the aromatic principle is fully developed. During this operation it should be constantly agitated to prevent burning, and the cover should not be removed until the cooling is completed, that the aromatic vapor confined within the vessel may be reabsorbed by the coffee as it cools. Coffee should be ground only as it is needed for the table, as the aroma is much better preserved in the whole seed than in the powder. In preparing the beverage, boiling water should be used; but the boiling should not be continued, lest the volatile properties of the coffee be driven off. All the desirable qualities of the coffee are better extracted and preserved when prepared by percolation, which should be done in a closely covered pot, of which there are now several kinds in use with percolators adjusted.

The adulterations of coffee consist largely of roasted peas and beans, or chicory root, ground with the coffee. A simple test for the purity of coffee is the fact that when pure it does not readily impart color to cold water, while adulterated coffee soon gives to water a light amber, gradually changing to a deep brown color.

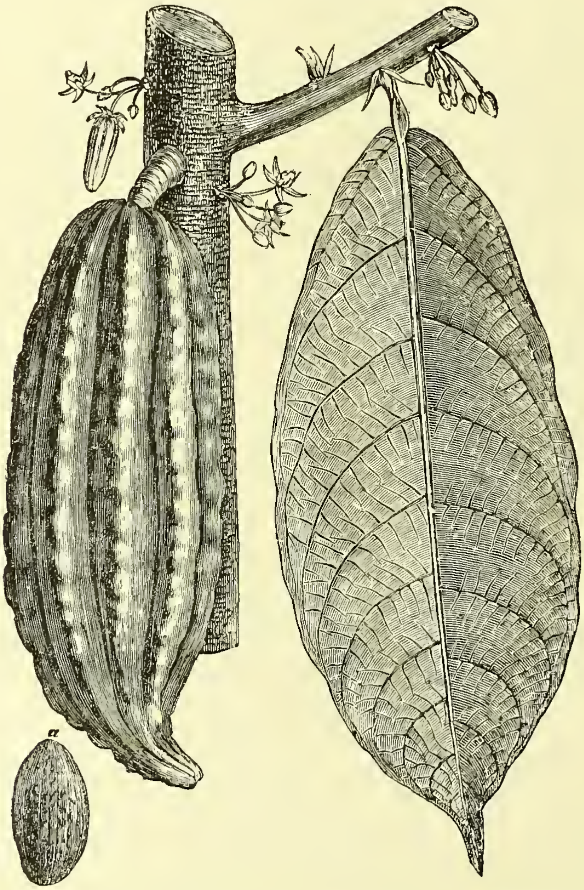
Coffee has a tendency to check the secretions of the skin and increase those of the bowels, while tea excites perspiration and has somewhat of an astringent effect on the bowels. Hence, tea is to be preferred in hot weather to coffee, the perspiration and subsequent evaporation following a cup of tea cooling the heated body, and the astringent property of the beverage lessening any tendency to diarrhœa.

Cocoa.—The cocoa bean, from which cocoa and chocolate are prepared, is the seed of a fruit resembling a cucumber, growing upon a small tree (*Theobroma Cacao*) in the West Indies, Mexico, and South America. Like tea and coffee, the cocoa bean requires heat to develop its aromatic flavor, and is roasted and ground like coffee to prepare it for use. It has an active principle called *theobromine* (which is similar in its properties to theine and caffeine) from forty to fifty per cent. of fatty matter, besides from twenty to twenty-five per cent. of albuminous and starchy material.

In consequence of the large proportion of fat in cocoa, it is necessary that this be diluted with some substance less rich and more easily digested, and for this purpose starch, arrow-root, sugar, etc., are mixed with the ground seeds, and constitute what is called

cocoa. Chocolate is made by mixing with the ground seeds sugar and spices, as cinnamon, cloves, vanilla, etc.

To obtain a good beverage from cocoa it should be boiled until the starchy matter is thoroughly cooked. As the cocoa bean contains a considerable amount of nutritious material, both cocoa and chocolate, when prepared for the table, are food as well as drink,



a

FIGURE 121.—The fruit and leaf of Cocoa (*Theobroma Cacao*). *a* represents one of the seeds.

and perhaps there is nothing which more promptly refreshes a weary and hungry person than a bowl of either one of these preparations.

Other beverages are used to some extent, but those above mentioned are the principal ones used throughout the world. Dr. Letheby says "that not less than 500,000,000 of the human race make use of an infusion of tea; that more than 100,000,000 drink

coffee from the roasted berry, and perhaps 2,000,000 from the dried leaves ; that about 50,000,000 drink cocoa, or use it as chocolate, and that not less than 10,000,000 of the inhabitants of Peru, Paraguay, and the Brazils use an infusion of maté.

FIGURE 123.—Maté.

Maté consists of the dried leaves of a tree called by botanists the *Ilex Paraguariensis.* Its use is restricted almost wholly to

South America, where it is estimated that at least 8,000,000 of pounds are consumed annually. It has an aromatic and very agreeable flavor, quite different from any beverage familiar to most people of this country. Its effects are somewhat similar to those of tea, and depend upon the presence of a peculiar acid as well as *theine*, which has been found in it. The mode of its preparation is as follows: a vessel (commonly made of a gourd) has a quantity of leaves put into it, together with sugar, according to taste, and is then filled up with boiling water. A tube, called a bombilla, with its lower extremity perforated with a number of fine holes, but otherwise closed, is then used as a sucker, and the infusion is taken while it is yet quite hot. If it is not drunk soon after being made, the infusion becomes black and unwholesome.

ALCOHOL AS A FOOD.

It is hardly possible within the limits of this work to discuss fully the class of beverages about which there is so much diversity of opinion, and which in themselves are so powerful for good or for evil; which, by a proper use, may afford pleasure and health, or, by an injudicious use, may be followed by the most disastrous consequences both to individuals and communities. As alcohol in its different forms is a powerful agent for good or for evil, the question of its relation to food is determined by the manner and extent of its use. It is contended on the one hand that alcohol cannot be a food, because when taken it is eliminated from the system without undergoing any change, and hence can contribute nothing to the growth and repair of the body, or to the development and support of animal heat. Again, it is argued, on the other hand, that although alcohol is detected unchanged among the different excretions of the body, it has never been shown that the entire amount taken at any one time is so eliminated, or that no portion of it performs the office of respiratory food, while it is natural to infer from the nature of its elements ($C_4H_6O_2$) that a portion of it, at least, would be as readily burned in the system as the fats or other hydro-carbons.

The experiments of Edward Smith on the action of the different forms of alcohol over the respiratory functions, made in 1856–9, have done much towards settling the question of the relation of alcohol to food, and yet the results of these experiments were by no means uniform. While he found that spirits of wine, diluted with cold water and taken in the absence of food, had the effect to increase the vital action, as shown by an increased amount of carbonic acid exhaled from the lungs, he also found that with the use

of brandy, whiskey, and gin, there was decrease of vital action as shown by a decrease in the amount of carbonic acid exhaled. With rum the effect was different, as by its use he found that vital action was invariably increased. Those liquors which contained fusel oil always exerted a depressing effect, and perhaps his experience with brandy may have been due to the fact that much of the brandy in use is prepared from potato whiskey treated with certain essences which impart to it the desired flavor. Good brandy that is distilled from grape wine ought to be, and is generally believed to be, one of the best of alcoholic liquors. Gin was found to depress vital action more than any other liquor, and as it is generally made of the poorest liquor flavored to the taste of the manufacturer, it is not strange that such results followed the experiments. While these results attended the use of inferior liquors, the better and pure specimens were more exciting and stimulating.

In continuing his experiments with the milder alcoholic liquors, Dr. Smith came to the conclusion that "from the statement of the chemical effects of the various members of the class of alcohols, it has been shown that, as foods, beers occupy the first place, then cider and perry, and then wines ; and as they sustain and increase vital action, they must be allowed as true foods. Of ardent spirits, rum alone exhibits the action of a food, while gin, brandy, and whiskey act as medicines by lessening vital action."

The relation of alcohol to food may be regarded favorably whenever it is necessary to improve the general tone of the system, by increasing the appetite and the digestion and assimilation of food. Under such circumstances, by the use of some one of the milder stimulants, an increased relish is given to the food, and the stomach is better enabled to supply the necessary secretion, and the process of digestion is aided. But if strong liquors are used without first being properly diluted, the effects are to harden the food, to diminish the gastric secretion, and thus to impede digestion, and eventually to bring about a chronic inflammation of the stomach, rendering it unable to digest ordinary articles of food. In order to secure the benefit to be derived from the use of alcoholic beverages, it is evident that they should be taken during meals ; and as the beers and light wines appear to stand at the head of alcohols in their relation to foods, it seems to be equally obvious that when a stronger liquor, as rum, is used, it should be reduced to about the strength of the milder ones ; and we may venture to say that when thus judiciously used, they will aid our food in nourishing the body, besides having the effect to retard waste of tissue, and in a measure to regulate the escape of animal heat.

The habitual use of intoxicating liquors as a beverage only, their effects upon the brain and the nervous system, the evil effects of intemperance, or a description of the drunkard's liver, cannot be regarded as subjects to be treated in a chapter on foods.

GENERAL REMARKS.

Climate and occupation have considerable influence on the demand for food, and these should, to a considerable extent, regulate our selections. Each climate abounds in the food productions best suited to the wants of its inhabitants, as are seen in the abundance of fish, flesh, and fats of the far north, the mixed supplies of animal and vegetable foods of the temperate regions, and the spontaneous productions of the torrid zone. While the inhabitants of the arctic regions live almost exclusively upon meat and fat, as food necessary to enable them to resist the depressing influences of their cold climate, and while those of the torrid zone naturally adopt the other extreme and live mostly upon a light vegetable and farinaceous diet, with acid fruits, foods containing a small amount of heating power, the inhabitants of the temperate climates live upon a diet between these extremes, and acquire their superior development on a mixture of animal and vegetable food. The arctic explorer from the temperate zone soon finds that the generous diet which so fully meets his wants when at home, falls far short of sustaining him at the extreme north, and he soon learns to appreciate the kind of food to which the native inhabitants are accustomed, drinking the cup of oil with the same eagerness and relish with which he receives a glass of milk in his native climate. It would be equally important for him on visiting a hot climate to make a corresponding change in his diet, as he would find his accustomed mode of living wholly unsuited to a tropical climate.

The active laborer requires a strong diet of meat and vegetables, while a person of sedentary occupations would be overfed and his digestive functions would be overtaxed by a similar indulgence. Temperament and disposition may also be somewhat controlled or modified by a suitable regulation of diet. While the diffident and irresolute person may be somewhat stimulated to action by a generous diet of animal food and a moderate indulgence in stimulants, the violent and over-sanguine are in the same proportion controlled by a more abstemious course of living.

We may err in the construction of our dietaries, in our method of cooking and manner of eating, in the quality of our food, or in the quantity taken at any one time. In the construction of our diet tables, the importance of variety has perhaps already been

sufficiently presented. We not only require a variety of articles in the preparation of our meals, that all of the elements necessary to the most healthy nutrition may be supplied, but frequent variations in our meats and vegetables, as well as in the mode of preparing them for the table, have the effect to keep the appetite sharpened and to relieve the palate of the unpleasant monotony attending too great a uniformity in diet; and we may, without doubt, accept the rule that in proportion as our food, when properly prepared, is relished and enjoyed, will it be digested and assimilated. We may go still farther, and say that whatever the palate instinctively rejects will not be well received and digested by the stomach—a rule we should remember when endeavoring to compel children to eat food which they dislike. Therefore, in order to bring our dietaries to the highest degree of perfection, we should not only select a variety of articles, but the combination should be such that one will supply the deficiency existing in another as it regards nutritive qualities, and that each may lend to the other some improvement in relish and flavor, so as to make our meals attractive and enjoyable. The style of cooking should be such as to develop the most agreeable flavors, and this cannot be governed by any arbitrary rule; for, while to a majority of stomachs the flavor of roasted meat is more agreeable, yet there are many who prefer some other style of cooking. Doubtless most persons enjoy, and will more readily digest meat that is well cooked, while a few may do better on that which is "rare done." In cooking both meats and vegetables, care should be taken to prevent the loss of any of the nutritive elements, of which sufficient has already been said.

In eating, we must remember that the teeth have an important office to perform, and their duty should not be transferred to the stomach. Food should be thoroughly masticated before being swallowed, by which we accomplish a double object: first, the substance is completely disintegrated, so that every portion of it is submitted to the action of the gastric juice; second, it becomes thoroughly softened by the action of saliva, which further prepares it for the process of digestion. If this precaution is observed, there is no objection to drinking freely at meals; but, in drinking to assist deglutition, we are likely to neglect mastication and swallow our food prematurely, thus overtaxing the stomach with work which should have been performed by the teeth. With such treatment the stomach is pretty sure to suffer soon or late with dyspepsia and its long train of attendant evils.

Eating between regular meals is a practice which ought not be indulged, because the stomach, as well as the muscles and brain,

requires its periods of rest, the interruption of which unfits it for its regular duties. The digestion of a hearty meal requires usually from three and a half to four hours ; and to a person who eats three meals a day, this does not afford any more time for rest than the stomach requires. Persons who from impaired digestion, or persons who in the early stages of convalescence from disease are unable to digest hearty meals, should eat but small quantities at a time, and more frequently. Concerning the quality of food eaten, it seems hardly necessary to say that sound meats and vegetables are by far the most useful as well as enjoyable ; but when we come to consider the effects of unsound, diseased, or putrid meat, we find that we are dealing with a question difficult to answer. While Edward Smith, after careful investigation, found no evil consequences following the practice of eating "braxy" mutton, others have regarded the food as highly dangerous, after witnessing serious results following its use. The same may be said of other meats of an unsound or a diseased quality. We have accounts of besieged cities, in which the residents have been compelled to live upon food not only unsound, but diseased and even putrid, with apparently little or no injury ; and again, it is the testimony of many careful observers that eating the meat of animals affected with rinderpest, or pleuro-pneumonia, is often the cause of malignant carbuncle, phlegmon, boils, etc., while there are many instances on record of disease caused by eating sausages made of diseased meat. (See poisons.) It is fortunate that our laws prohibit the use of meats from animals that have died from disease, or that have been slaughtered when not in good and sound condition, for it seems impossible that meat tainted with disease can be in any wise a proper food for human beings. As regards unripe fruits and decayed vegetables, it is the experience of every one who has used such articles of food, that there is perhaps no more frequent cause of gastric and intestinal derangements than their daily, or even occasional use.

The old adage, "No one ever repented of having eaten too little," and the oft-repeated injunction, "Always get up from the table hungry," should both be received with some grains of allowance—the former somewhat doubtful in point of fact, the latter a rule more honored in the breach than the observance. A deficiency of food is sure to be followed by a general prostration of powers, mental as well as physical, and, if continued for any great length of time, the individual becomes an easy victim to disease. On the other hand, gormandizing fills the stomach with more food than can be digested ; overtaxes the digestive functions, causing flatulence, offensive eructations, and dyspepsia, all resulting from

the decomposition of undigested portions of food. Plenty of good food, sufficient at all times to satisfy the feelings of hunger, without overfeeding, is one of the main conditions necessary for the enjoyment of perfect health.

The following works are recommended to those who desire to further pursue this subject :

A Manual of Diet in Health and Disease. By Thomas King Chambers. Philadelphia: Henry C. Lea. 1875. 8vo, 310 pages. Cloth, $2.75.

Food: Its Varieties, Chemical Composition, Nutritive Value, etc. By Henry Letheby, Ph.D., etc. New York: William Wood & Co. 12mo, 255 pages. Cloth, $2.25.

Foods. By Edward Smith, M.D., etc. New York: D. Appleton & Co. 12mo. $1.75.

Food and Dietetics, Physiologically and Therapeutically Considered. By F. W. Pavy, M.D , etc. Philadelphia: Henry C. Lea. 1874. 8vo, 574 pages. Cloth, $4.75.

Popular Lectures on Food. By E. Lankester, M.D., etc. London: Hardwicke & Bogue. 12mo, 385 pages. $1.80.

The Chemistry of Common Life. By James F. Johnson, M.A., etc. New York: D. Appleton & Co. 2 vols. 12mo.

E. H. JANES, M.D.

AIR IN ITS HYGIENIC RELATIONS.

Encircling our globe and adhering to its spherical surface on every side, and travelling with it through space at the rate of about 66,000 miles an hour—lighter than either land or water and resting upon both, is a gaseous envelope which we call the atmosphere. It extends to a distance of about forty-five miles from the surface, being at its greatest density at the level of the sea, and gradually rarefying as the distance from that level increases. Whether this is the extreme limit of the atmosphere, or whether, as many have claimed, there may be an ethereal atmosphere extending indefinitely into space, is not a matter for discussion on this occasion. We have only to study the atmosphere as the medium in which we live, and move, and breathe—the source from which animals and plants derive the first elements of their existence. It furnishes the primary elements of our living tissues, and receives again the gaseous products of decay and death. Its respiration is the first act of animal life, as well as our last expiring effort, and hence its importance as a prime necessity to all living things. It is also called air, although the term air was applied by the older chemists to various gases, each being designated according to some one of its peculiar characteristics.

Thus, in 1670, Mayo discovered, by a series of very careful experiments, that a certain portion of the atmosphere supported combustion and respiration. To this, which is now known as oxygen, the most important element in nature, he gave the name of "fire air," and proved by further experiments that its action within the body was similar to that upon the candle, viz. : by coming in contact with certain particles in the blood and combining with them, animal heat was developed and maintained. More than one hundred years afterwards, Priestley succeeded in obtaining it as a separate gas, and gave it the name of "dephlogisticated air" in accordance with the erroneous theory of Becher and Stahl, that all combustible substances contained an element which they termed phlogiston, and which was given up during combustion. As the acknowleged supporter of life, oxygen was called "vital air;" and for obvious reasons ammonia was called "alkaline air;" hydrogen, "inflammable air;" carbonic acid, "fixed air," etc. These expressions are now seldom or never used, and the term air must be regarded as only another expression for atmosphere. The functions which air performs in the support of life and health, the importance of its purity and freedom from contaminations of whatever kind, the evil effects of breathing

impure air, and how to prevent or get rid of these impurities, will constitute the subject of the present chapter.

Physical Properties of Air.

Although invisible, and so light and thin that we are scarcely sensible of it except when in motion, yet, like solid and liquid bodies, it is like them material, and possesses many of their physical properties. It has impenetrability, by which we are to understand that it will not allow the entrance of another body into the space which it already occupies, or rather, it will not continue to occupy a space into which another body is inserted. If we place a solid body in what we call an empty tumbler, or pour into the tumbler any liquid substance, a volume of air equal to the cubic measurement of the solid or liquid matter will be displaced in the same manner that a tumbler filled with any liquid will lose a portion of its contents upon the insertion of any solid body. If, however, we plunge an inverted tumbler into a vessel of water, we shall find that whatever distance we press it down, the tumbler will not be entirely filled with water; but the air, having no means of escape, will be compressed into a smaller space, though still continuing to occupy a portion of the tumbler into which the water cannot be forced; but, by withdrawing the tumbler, we shall find that as the water recedes, the air, being relieved from the pressure, is gradually restored to its original volume, displaying another physical property—that of elasticity, or contracting and expanding by the application and withdrawal of certain forces.

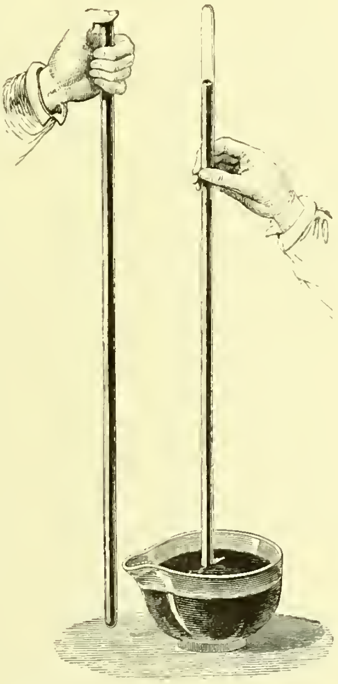


Figure 123.—Torricelli's experiment.

Although air is so thin and apparently so light as to seem to us as nothing, yet, like all material bodies, it is a ponderable substance, by which is meant that it has weight. This fact was suspected by the older philosophers; it was believed by Galileo, and was haply demonstrated by Torricelli in 1646, in the following manner: He took a glass tube three feet in length and filled it with mercury; then carefully inverting it and plunging

the open end into a basin containing that metal, he found that the mercury in the tube fell to about thirty inches above the level of that in the basin, leaving a vacuum above, the weight of the air on the surface of the mercury in the basin being sufficient to sustain the column of mercury to the height of thirty inches.

A similar experiment with water showed that a column of that liquid could be sustained by the same force to a height of thirty-four feet, from which it is ascertained that the column of mercury thirty inches high is equal in weight to a column of water thirty-four feet high, and that either is equal to a column of air of like area extending to the extreme limits of the atmosphere. Now, as a column of mercury of thirty inches, each side of which measures one inch, was found to weigh about fifteen pounds, it was thus ascertained that the weight or pressure of the atmosphere was equal to about fifteen pounds to every square inch of surface; and by calculating the number of square inches on the surface of the body of a man of ordinary stature, and multiplying this by fifteen, we get something like fifteen tons as the approximate amount of pressure which each adult human body sustains. The reason we are not crushed by this enormous weight is that the air presses equally from every direction, from above, below, and around, while the fluids and air within the body constitute a sufficient degree of resistance to this external pressure to establish the necessary equilibrium.

A familiar illustration of the pressure of the atmosphere is the difficulty in separating two bodies with perfectly smooth surfaces in contact one with the other; so also in the painful operation of cupping, the air being in a measure expelled from the cup, the pressure upon its external surface holds the cup firmly to the body, while that portion of the surface of the body thus included, being deprived of the ordinary degree of atmospheric pressure, yields to the counter-pressure from the fluids within.

Perhaps a more striking illustration of the weight of the atmosphere is experienced by covering with the palm of the hand one end of an open tube of sufficient diameter to require nearly the entire palm to cover it, placing the other end on the plate of an air-pump and exhausting the air. Soon as there is even a partial vacuum within the tube, we become sensible of an intolerable weight on the back of hand, which is only the weight of the atmosphere not meeting with the resistance of an equal pressure from below.

Pressure of the atmosphere is of great importance as regards our physical wants, and varies widely according to altitude or distance from the level of the sea, about one-half of its entire weight

being confined within a distance of 2¾ miles above that level, so that if the mercury in the barometer (the instrument invented by Torricelli) stand at thirty inches at the level of the sea, at an altitude of 2¾ miles it will mark fifteen inches. If we ascend that distance, or indeed to any considerable height, we begin to feel the effects of losing a portion of this external pressure ; and if we continue to ascend, these symptoms are increased to a painful degree. The thin, rarefied air fails to satisfy the wants of the system, and breathing becomes hurried and difficult. The body, being deprived of a large portion of this external pressure, yields to that of the fluids within, and there is a general tendency of the tissues to expand, the blood-vessels become swollen and sometimes so yielding to this internal pressure as to produce hemorrhages from the mouth, nose, or lungs, severe vertigo, and even apoplexy.

The weight of the atmosphere often varies from other causes than difference in altitude, such as variations in aërial tides, winds, storms, etc. As was before stated, the usual density at the level of the sea is sufficient to sustain the column of mercury in the barometer to a height of thirty inches, though it may be so light as to cause the mercury to fall to twenty-eight inches, making a range of two inches which is about the extent of variation at or near the sea-level. It has been ascertained that the falling of the mercury one inch indicates that the weight usually sustained by the human body is reduced by more than one thousand pounds, and hence there is a variation of more than two thousand pounds in the weight sustained by each adult body. When the density is at the minimum, we soon are able to recognize the condition by our senses. The earth and the sea being relieved of a certain amount of pressure, evaporation is facilitated, and the atmosphere becomes loaded with moisture, and also with poisonous miasms and effluvia which are developed by the decay of organic matter on or beneath the surface of the ground.

In this condition of the atmosphere, invalids suffer more from their various affections. Asthmatics find that their symptoms are aggravated, varicose veins enlarge and healing ulcers may break out afresh, the whole system losing tone in proportion as it is deprived of the support afforded by the normal degree of atmospheric pressure.

The action of the atmosphere in moderating and diffusing the light and heat of the sun, which without such action would daily submit us to the almost instantaneous change from total darkness to the glaring light and heat of mid-day, and again at sunset to the equally sudden change back to total darkness ; in the produc-

tion and conveyance of sound, without which there would be no music nor any audible means of communication ; its becoming rarefied by the sun's heat, thus giving rise to motions varying in degree from the gentle breeze to the violent whirlwind—how these movements of the air are utilized in the various industries of mankind, especially in commerce, are all matters of interest which we cannot dwell upon in a work of this kind, and we will next turn our attention to the composition of the atmosphere.

Constituents of Air.

Air completely deprived of moisture is composed principally of two gases, oxygen and nitrogen, in a state of mixture—not chemical combination, the proportion of oxygen being from twenty to twenty-one volumes in a hundred, rarely below the one or much above the other. In its normal condition, however, the composition of air is not limited to these two gases, there being two other constituents which are regarded as essential, viz. : watery vapor and carbonic acid ; so that the average composition of air is given as follows : oxygen, 20.61 ; nitrogen, 77.95 ; watery vapor, 1.40 ; carbonic acid, 0.04.

There are also traces of ozone and ammonia, which are regarded by some as possibly essential, besides traces of various gases and other impurities depending upon local conditions. Of the essential constituents of air, *oxygen* is by far the most important. It is the presence of this which gives to air the power of supporting animal respiration, and the ordinary processes of combustion, which consist in, and are maintained by, the combination of oxygen with the carbon of the living or burning body. It is destitute of color, taste, and smell ; it is about one-tenth heavier than common air, and between three and four gallons of it may be dissolved in one hundred gallons of water. Animal life is dependent on it for support, and no living creature, either on the land or in the water, could survive if deprived of this important, vital element. When pure, oxygen will cause combustible bodies to burn with greater brilliancy and rapidity, and will cause to burn readily many substances which are commonly considered incombustible. So will animals, in breathing pure oxygen, have their respiration, circulation, and indeed all of their animal functions stimulated to an unnatural degree.

So far as we know, oxygen is the only element in the air which is a direct sustainer of life. It is this which gives to the blood its healthy properties and bright color, by removing from it its impurities. It is the source of energy and power to all of the vital

functions, whether of the brain, the muscles, the stomach, or the heart. It is the source of animal heat, and keeps the body alive and warm by uniting with, burning up, and thus removing from it those waste substances which, if allowed to remain and accumulate, would, in a short time, poison the system and destroy life. This it does by quitting its relation with nitrogen, and combining with the carbon and hydrogen of the effete matter, producing a slow combustion, which develops animal heat, and forms carbonic acid gas and watery vapor, which escape through the breathing-organs. During this process of respiration the air is introduced into the minute air-cells of the lungs, which are numbered by the million, where it is separated from the venous blood only by a very thin membrane, through which an exchange takes place between the venous blood and the air, the latter gaining carbonic acid and moisture—products of the combustion just mentioned—for which it has exchanged its oxygen, the former losing these products of combustion and gaining oxygen. The oxygen is then taken by the red corpuscles of the blood and carried to every minute part of the body, combining with the carbon and hydrogen of its waste matter, thus supporting without interruption the animal heat, and continuing without interruption its purifying functions.

By inhaling air that has been deprived even of a small proportion of its oxygen, we reduce the vital functions and energies to a point below the natural condition of health. We complain, under these circumstances, of languor, listlessness, irritability of the nervous system, dulness of the intellect, indisposition to mental effort, headache, and a general prostration of physical and mental energy, the natural result of the presence of poisonous matter in the blood, which the deficient supply of oxygen has failed to remove. From this we learn that, as oxygen is the natural stimulus to the functions of the human body, and as its complete denial must prove rapidly fatal, so must a diminished supply prove proportionally injurious ; and, therefore, whenever or wherever persons are assembled in crowds sufficient to consume the oxygen more rapidly than it can be supplied, the health of all will suffer in proportion to the denial of this important element.

Nitrogen, the second, and, by measurement, far the greater constituent of air, is, so far as we know, incapable of exerting any influence either in sustaining or destroying life ; neither can it support combustion, nor has it, so far as we know, any peculiar action on the blood. It is without color, taste, or smell, is soluble in water only in the proportion of two parts in one hundred, and its only mission appears to be to dilute the more stimulating oxygen, and thus modify its action to a degree which is in har-

mony with the natural requirements and functions of animal life.

A third constituent, of which a certain proportion, varying in amount as the temperature varies, is necessary and always present in the normal condition of air, is *watery vapor.* Air which is perfectly dry cannot be breathed without creating some very unpleasant sensations. Its attraction for moisture is so strong that it dries everything with which it comes in contact, and hence the lining membrane of the mouth, the throat, the breathing-passages, and the eyes, all become dry and parched; the skin loses its softness, becoming harsh and dry; as the thirsty air appropriates to itself every particle of moisture from these surfaces. We have all experienced to some degree the unpleasant effects of breathing the air of a house warmed by a hot-air furnace, where provision for the evaporation of water has been neglected.

On the other hand, if the air be saturated with moisture it refuses to receive any more, and we feel uncomfortable from a want of evaporation. During evaporation much heat is rendered latent by the vapor abstracted from the evaporating surface, and hence, in very warm weather, when the air is what we call dry—that is, when it contains a moderate amount of moisture—evaporation from the surface of the body is sufficiently active to produce a cooling effect, without reducing any portion of the body to an abnormal condition of dryness; but if the air be loaded with moisture, and we perspire freely, the perspiration, instead of escaping by evaporation and thereby cooling the body, remains and saturates the clothing, rendering it damp and uncomfortable, while the animal heat continues to accumulate. In warm weather we suffer much more from the heat when the atmosphere is moist than we do when it is dry, because, in the latter case, we have the cooling effect of evaporation.

Cases of sunstroke, and other affections due to prostration by heat, are more frequent when there is heat connected with moisture than when the air is dry, even though of a higher temperature. In the former condition we feel languid and spiritless; we complain of the weather as "muggy" or "sticky;" we become drenched with perspiration, feel an aversion to any kind of exertion, and easily yield to fatigue. A cool and dry air is highly invigorating, and, if it be still as well as dry, we can endure a very low temperature without suffering, while a moderately cold and moist air makes us feel uncomfortable and chilly.

The amount of watery vapor which the air is capable of containing, as has already been said, depends on the temperature, and hence air at a low temperature which is saturated, would, upon a

considerable rise in temperature, be called dry, without having lost any of its vapor, the absolute amount remaining the same. The following figures illustrate these variations in the capacity of air at different temperatures for containing moisture: At 32° (the freezing-point) one cubic foot of air is capable of containing 2.13 grains of watery vapor; at 43° it will hold 3.08 grains; at 52°, 4.39 grains; at 62°, 6.17 grains; at 72°, 8.54 grains; at 90°, 14.85 grains. From these figures we are enabled to understand why it is that the air of a room warmed by a hot-air furnace is so dry and irritating to our breathing-passages even in damp weather. The out-door air, at 32°, completely saturated with moisture, it may be, enters the hot-air chambers of the furnace, where it is heated and distributed through the house hot, dry, and parching as the air of a desert; not that it has lost any of its moisture, but its capacity for moisture is so increased by the elevated temperature that the small amount which saturated it at 32° is now imperceptible. We here see the necessity of connecting with every hot-air furnace suitable means for the evaporation of water, that the air, as it becomes heated, may supply itself with the much-needed proportion of vapor. Evaporating pans should be so constructed as to present to the air as large a surface of water as possible, for if the surface be small the evaporation will not be equal to the demand, and we shall suffer the consequences of breathing a dry atmosphere.

From what has been said it is obvious that the terms dry and damp, as applied to the air, do not indicate the presence of any absolute amount of vapor, but only the relative quantity of what the air is capable of holding, and that actually present, a quantity hardly perceptible at 80° being sufficient to saturate the air at 32°. As the air cools and the temperature descends to that degree at which the vapor begins to condense, or, in other words, to the degree of saturation, and we begin to see watery particles deposited on cold surfaces, as on glass or marble, that degree of temperature is called the dew-point. If the temperature of the dew-point be low, it indicates a small amount of vapor present; if it be high, it shows that there is a larger amount, though the relative amount is the same in both instances as it always is at the dew-point.

The instrument which assists us in determining the relative humidity of the air is called the hygrometer, of which there are three in use; but the one best adapted to popular wants is constructed with two delicate thermometers, as near alike as possible, the bulb of one being covered with a strip of muslin, the end of which is placed in a small reservoir of water attached to the instrument. The muslin covering the bulb soon becomes wet by

capillary attraction, and evaporation commences, the effect of which is to cool the bulb and cause the mercury to fall. As the mercury in the dry bulb indicates the real temperature, that in the wet shows the temperature of evaporation ; and, if the difference between the two is great, we know that the relative amount of vapor in the air is small and evaporation is active ; if the difference be slight, it shows that the air is moist ; if both bulbs indicate the same degree of temperature, it shows that the air is saturated with moisture, and there is no evaporation from the covering of the wet bulb. By taking the difference of temperature, as indicated by wet and dry bulbs, and by the use of tables and factors, we are enabled to determine the temperature of the dew-point, the amount of vapor in a cubic foot of air, and the relative humidity or percentage of saturation ; but an explanation of these calculations does not come within the province of a work of this kind. We may judge by the hygrometer pretty accurately whether the amount of moisture present is such as to be most conducive to health and comfort, the most desirable degree of humidity being indicated by a difference of from six to eight degrees in the two thermometers. If the difference increase considerably beyond this, we shall notice that the air is dry ; and, if much less, there will be an unpleasant degree of humidity.

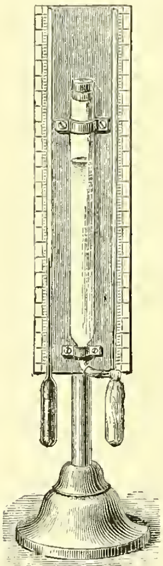


FIGURE 124.—Hygrometer.

The air receives its moisture principally from the ocean. The heat of the sun on the surface of the water causes a portion of it to evaporate, and in this way the hot, dry air of the tropics becomes saturated with vapor, which it carries to colder regions, where it is condensed in proportion to the falling temperature. The same takes place wherever the heat of the sun, and air not already saturated, act upon a surface of water, no matter how small, and in this manner a quantity of water equal in volume to 90,000 cubic miles floats through the atmosphere annually, taken up in the form of invisible vapor, and carried over all parts of our globe, descending here and there in the form of refreshing dew, the gentle shower, or the more violent storms of rain and snow.

Carbonic acid is the fourth and last of the essential constituents of air, the proportion being .04 of one per cent, or four parts in 10,000 of air. It is not a simple element, like oxygen and nitrogen, but, like water, it is a compound, and, as has already been stated, is the result of combustion, or the union of carbon and oxy-

gen, in the proportion of one atom of carbon to two of oxygen. It must also be remembered that carbonic acid is produced by animal respiration, which, as has already been explained, is a slow form of combustion. This gas is without color, but has a slightly acid odor and taste, and is the gas which gives to soda-water and other effervescing beverages their agreeable pungency. It is developed in large quantities during the process of lime-burning, nearly half of the weight of the limestone being given off in this form. It is heavier than air, one hundred cubic inches of air weighing about thirty-one grains, while the same volume of carbonic acid weighs about forty-seven grains. Any considerable increase over the normal proportion would be detrimental to health, and air containing ten per cent. of it would prove speedily fatal to a person inhaling it.

In breathing, we should be supplied with a sufficient amount of fresh air to so dilute the expired air, that the carbonic acid will not accumulate much beyond its normal proportion. The supply necessary to effect this has been variously estimated at from 600 to 1,600 cubic feet per hour. The amount of air inhaled may be stated in round numbers to be four hundred cubic inches per minute, the oxygen of which unites in part with the carbon in the blood (combustion), so that the expired air contains from four to four and a half per cent. of carbonic acid, or about one hundred times the amount contained by the air in its normal condition; hence the large supply necessary in order that this expired air may be sufficiently diluted. Were it not for the diffusive power of gases, and did carbonic acid obey the law of gravity alone, the atmosphere would become so contaminated by the accumulation of the poison as to be rendered incapable of supporting life; but though heavier than air, and generated near the earth's surface, it is soon diffused, and found in elevated places as well as near the ground. This diffusive power of gases is of great importance to us, as through its agency the air of towns and houses is, to a great extent, purified.

It is not by diffusion alone, however, that the air is purified. The world is so constituted that one kingdom of nature lives, in part, upon the wastes of another; and thus the waste thrown off by the respiration of animals, in the form of carbonic acid, is absorbed by the vegetable kingdom, when a change, the reverse of that which occurs in the animal system, takes place, the carbon being separated from the oxygen, and appropriated to the life and growth of the plant, while the oxygen is returned to the air in its purity, to commence anew the organic cycle just completed.

We see from this the important office which plants fulfil in

purifying the atmosphere, yet it should be added that it is only while under the influence of light that they are capable of performing these functions, and that during the night-time this action ceases, and to some extent the reverse takes place.

This gas sometimes accumulates in deep wells and vats more rapidly than it can be diffused, and in such places its presence in large quantities may readily be detected by lowering a lighted candle into the suspected place ; this gas not being able to support combustion, the candle will be extinguished either entirely or partially, according to the amount of the gas present. Many cases of sudden death have followed the descent into deep wells that had been closed for a long time, and where this gas had accumulated without any means of escape. Before such places are entered they should be well exposed to the air by being left open for some time, that diffusion may take place ; and the accomplishment of the object may be hastened by the introduction of slaked lime, which readily takes up the carbonic acid. Frequent and prolonged tests with a lighted candle will show when the air in the place is sufficiently purified to support combustion ; and it should be the invariable rule not to enter such a place until the candle not only burns, but continues to burn brightly and clearly ; otherwise it is not in a condition to support respiration.

In common with carbonic acid, and as its constant companion in expired air, there is always a certain portion of *organic matter*. This is an impurity which, though variable in quantity, is not so readily diffused as are the gases, and hence it lurks about in our rooms, it attaches itself to our clothing and furniture, and continues to contaminate the air long after the surplus amount of carbonic acid has disappeared. This dead organic matter escapes from the lungs during respiration, and also from the surface of the body, and, when present in any considerable quantity, it is readily detected by its peculiar odor, as, for instance, in an unventilated bed-room that has been occupied during the night ; in crowded assemblies, and in street-cars, even after their living freight has been discharged. Dr. Parkes attached a good deal of importance to the early detection of this odor, as indicating that the limit of what he termed "permissible impurity" had been passed.

The air within a dwelling occupied by living beings cannot be maintained in the same degree of purity as that of the out-door atmosphere, of which the normal proportion of carbonic acid, it will be remembered, is four parts in 10,000 of air ; and, recognizing this fact, Dr. Parkes made an allowance of two parts, making six parts in 10,000 of air the limit of permissible impurity. Whenever the proportion of carbonic acid exceeds this, we begin to detect it

by the peculiar odor of dead organic matter, and should look well to our means of ventilation and air-supply. For this reason carbonic acid produced by respiration is more to be dreaded than that produced by fermentation and combustion. The one poisons more on account of its negative qualities, by being substituted for oxygen, and depriving the system of a certain amount of that life-sustaining gas, the result being a failure to effect a complete aëration of the blood, the amount of oxygen taken in being insufficient to combine with and remove all of the waste matter, a portion of it remaining in the system, and contributing slowly, perhaps, though gradually and no less surely, to undermine the most robust health, and to destroy life. Carbonic acid produced by respiration, in addition to the evils just mentioned, has mingled with it the organic matter which has escaped from the system by the lungs and skin, and the individual who breathes it suffers both from the poison retained in the blood, and from the reintroduction of that which has escaped. This is what is known as crowd-poison—rebreathed air loaded with effete organic matter—and is the cause of those low fevers which we call typhūs, jail, and ship fever, and other affections depending upon the presence of animal poison. The symptoms of poisoning by carbonic acid are throbbing headache, a feeling of fulness and tightness across the temples, giddiness, palpitation of the heart, loss of memory, a buzzing noise in the ears, disturbance of vision, immediately followed by a strong disposition to sleep. The pulse is now reduced in frequency, the breathing becomes slow and difficult, the skin is cold and livid, convulsions and delirium follow, and finally death closes the scene.

Thus we have seen that what is considered, when present in its proper proportion, an essential constituent of the atmosphere, if largely increased in quantity becomes speedily destructive to life; and we may briefly recapitulate as follows: Carbonic acid is a normal constituent of the atmosphere when present in the proportion of .04 per cent.; .06 per cent. is the limit of permissible impurity, and it becomes dangerous to life in proportion to its increase beyond that ratio. Hereafter, whatever may be said regarding it will be under the head of impurities.

There are two other substances, traces of which are generally present, and are regarded by some as possibly essential constituents of the atmosphere; these are *ammonia* and *ozone*. It is believed that the mere traces of ammonia found in the atmosphere are not only harmless, but serve a useful purpose in furnishing nitrogen to the vegetable kingdom. When present in excess, however, it becomes an impurity, and as such further reference will be made to it presently.

Ozone is usually present in fresh air, though generally not in the close air of towns and dwellings. It is believed to be oxygen gas in a somewhat condensed form, and is produced by the action of electricity on the oxygen of the air—hence its presence after a thunder-storm—also by the slow combustion of phosphorus, the action of sulphuric acid on permanganate of potassium, and various other methods. Its office appears to be to oxidize organic matter and other morbific agents which float in the air ; hence, when absent, zymotic diseases, such as fevers and cholera, are much more likely to prevail than when it is present. From the action of ozone in purifying the atmosphere it has been called "nature's scavenging agent." On the other hand, when present in excess, it is believed by many to cause catarrh and bronchial affections by its irritating action, and even to produce epidemics of influenza. Others, however, believe this statement to be based upon its irritating effects in the laboratory rather than upon careful observation, and Dr. Parkes says that at present it may be safely said there is no proof of such an origin of epidemic catarrhs. Ozone exists in the largest proportion in the atmosphere immediately over the sea ; it is also generally present in the open country and in the suburbs of towns : it is not so common in thickly populated towns, and rarely found within crowded dwellings, as it is used up in oxidizing the organic matter in the air of such localities.

We now come to consider briefly the accidental or non-essential constituents of air generally regarded as impurities ; and we may begin by saying that their name is legion, for everything that can exist in a gaseous form may be found in the air of places at or near which these several gases are generated. Besides these we have suspended impurities of mineral, vegetable, and animal matter, acting either as mechanical irritants or as specific poisons. Among the gaseous impurities we have, as the one most frequently present within our dwellings, an excess of carbonic acid, mention of which has already been made. Then we have *carbonic oxide*, a gas generated by combustion where there is a limited supply of oxygen. As this gas is often present and confined in unventilated apartments warmed by stoves or furnaces, and, if breathed, acts as a direct poison to the blood, it is proper to give it a little of our attention here. It differs from carbonic acid in this, that it contains only one part of oxygen to one of carbon, whereas carbonic acid contains two parts of oxygen to one of carbon—the latter gas being the product of complete, the former of incomplete combustion. Its poisonous action is much more lasting than that of carbonic acid, as it attacks the red corpuscles of the blood, and, by paralyzing them, destroys their ability to convey oxygen, which

appears to be their principal function, and upon which the removal of waste matter from the blood depends. This gas is readily generated by the burning of charcoal, and in this way has often been employed as a means of suicide.

Modern experiments have shown that carbonic oxide readily passes through cast iron heated to redness, and hence the unhealthfulness of the atmosphere in close rooms warmed by stoves or furnaces, the sides of which are apt to become red-hot, thus allowing the escape of this gas, and giving rise to the severer forms of headache and giddiness experienced in unventilated rooms warmed in this manner. It is produced more from the harder varieties of fuel, such as anthracite coal, than from the lighter fuels which burn with a flame, and may be found accumulated in the upper portion of the stove soon after it has been replenished with a fresh supply of fuel. Any one can test its presence by suddenly opening the door of a stove in which the supply of coal is but partially ignited, when a slight explosion or "puff" is heard, and a pale blue flame is seen for a few moments above the surface of the freshly added coal. Its presence is due to the carbonic acid, which is formed in the lower portion of the stove, parting with one portion of its oxygen as it ascends through the heated mass, thus being changed to carbonic oxide. The same sometimes occurs in blast-furnaces. The flame which is commonly seen issuing from the mouth of a high chimney is not a continuous flame passing through the entire length of the chimney, but it is this gas which has accumulated within from imperfect combustion of the fuel in the furnace, and in a condition of intense heat is brought in contact with the oxygen of the atmosphere, when a union of the gases takes place, and combustion is completed.

We see, therefore, that the escape of carbonic oxide is not only detrimental to health, but is a great waste of fuel, and those stoves and furnaces which are so constructed as to consume this gas are not only more healthy but more economical than those which allow it to escape. We are also taught a lesson in regard to the management of our stoves and furnaces, in order that we may avoid the evil effects of this poisonous gas. We should see that the castings are perfect, with as few joints as possible, and these properly cemented, and should not allow the iron to be heated to redness. The heat is retained and given off slowly by having the fire-pot lined with fire-brick, thus avoiding any necessity for allowing the iron to become red-hot. If we close the smoke-pipe with a damper in order to economize fuel, we prevent escape by the chimney of whatever carbonic oxide may have accumulated over the fuel, and

favor its escaping through the heated iron, through imperfectly fitting joints, a possible crack or flaw in the iron, or a loosely fitting door; and if we shut off the supply of air we deprive the fuel of the necessary amount of oxygen to insure complete combustion, and favor the accumulation of carbonic oxide gas, thus laying the foundation for future ill-health—the inevitable consequence of breathing an atmosphere contaminated with this treacherous poison.

Another gaseous impurity is an excess of *ammonia,* the irritating effects of which on the eyes and throat have been felt by most persons. It is given off in great abundance from large stables and manure-heaps, and is believed by many to increase the severity of many diseases in such localities.

Sulphuretted hydrogen and kindred gases and effluvia, which escape from imperfect sewers, untrapped waste-pipes, privies and cesspools, contribute largely to the impurity of the air in many dwellings, and often induce diseases of a typhoid type. So thoroughly are the minds of the medical profession and of health authorities imbued with the truth of this statement, that no physician or health officer having a case of typhoid fever under his care can be said to have done his duty without having instituted a careful investigation as to the source of any impurity in the air of the dwelling. Besides typhoid fever, there are other affections of a minor character, perhaps, which appear to be induced by this condition of the air, such as headache, sickness to the stomach, diarrhœa, loss of appetite, general uneasiness, and loss of health.

Gases emanating from various industries affect health mostly by their irritating qualities, causing bronchitis, pneumonia, ophthalmia, and like affections. Among these are sulphurous, hydrochloric, and nitrous acids, and chlorine. given off in the form of vapor from bleaching establishments, alkali works, steel works, and chemical establishments. Zinc fumes from brass foundries, arsenical fumes from copper-smelting, emanations from gas works, organic vapors from fat-rendering and other branches of industry having in view the utilizing of animal matter, may also be numbered as among the more common impurities of this class.

Mineral substances, in the form of dust with minute particles of vegetable and animal matter, make up what are known as suspended impurities, many of them affecting health and even shortening life by the severe irritation they produce on the tender surfaces of the breathing-passages. Mineral substances affect somewhat in proportion to the shape or angularity of the particle; and a large majority of the cases of severe bronchitis, consumption, and other pulmonary affections among workmen, may be

traced to the mechanical irritation produced by inhaling the particles of dust arising from their work. Such is the case among miners and colliers from breathing particles of coal, sand, steel, or other metal, among whom the death-rate from pulmonary disease increases rapidly as they advance in age beyond thirty-five. Workmen in pottery, china scourers, grinders of steel, button makers, operatives in cotton, woollen, and flax factories, stone-cutters, and, indeed, all persons engaged in work from which they are compelled to inhale an irritating dust, are liable to attacks of nasal or bronchial inflammation, bleeding from the lungs, pneumonia, or consumption.

Workers in lead and house-painters not only inhale the dust of lead, but from neglect of washing their hands before eating, particles of lead are swallowed, with the effect of producing colic or the severer forms of lead-poisoning.

In the manufacture of wall-papers and of artificial flowers arsenical compounds are sometimes used, and the workmen, as well as many persons who occupy rooms papered with such papers, by inhaling the dust, receive into their systems particles of arsenic, and eventually suffer from the effects of arsenical poisoning (see also poisons).

The air of the sick-room becomes contaminated with organic matters escaping from the patient, often increasing the severity of the disease and retarding recovery. We also have, in addition to exhalations from the patient's body and the products of respiration, emanations from the excretions of the sick, from foul poultices, chronic ulcers, suppurating wounds, and, in cases of contagious disease, the peculiar germs by which the disease is propagated. The foul air of a sick-room, where ventilation and other means of purification are neglected, not only aggravates the sickness and renders recovery tedious, but often develops other diseases, especially erysipelas and hospital gangrene, the poison of the latter being exceedingly persistent, so much so that it has been found necessary to remove and rebuild the entire walls of a hospital ward, in order to insure to fresh patients safety from an attack of this disease. Puerperal (childbed) fever may also be developed from the impure air of a lying-in room. The patient in this condition is extremely susceptible to the influence of zymotic poison, and whether the morbid matter be due to the near proximity to some contagious disease, or to the escape of sewer-gas, or to exhalations from any matter in a state of putrefaction, the danger to the patient is equally imminent, and cannot be overestimated.

The air of the nursery, where the younger children of well-to-do

families pass most of their time, particularly in cold or stormy weather, requires especial attention, and every effort should be made to prevent those contaminations which are so frequently the bane of infant life. Neglecting to remove from the room articles of soiled clothing, allowing vessels containing the excretions of the child to remain and befoul the air until it suits the nurse's convenience to dispose of them, or suspending the baby's wet napkin —even without being previously washed, as is often done—that it may dry by the warmth of the fire or of the sun, and thus mingle its foul urinous exhalations with the air of the room, are practices which cannot be too severely censured. Nothing short of absolute cleanliness will insure pure air in the nursery, and this can only be secured by promptly removing every soiled article, all excretions and wash-water, and whatever dust and dirt may have been introduced from without. No unnecessary furniture, curtains or other drapery should be allowed, nor anything that can absorb and retain noxious effluvia. We should see that the furnishing of the nursery in all of its details is as plain as possible, remembering that the delicate breathing-organs of the young child should be supplied with air free from impurities, in order that its feeble respiration may not be impaired. All this is important, for the child cannot have the full benefit of respiration if the limited air-space of the nursery is reduced by the presence of bulky furniture, or made to afford room for any description of articles which may harbor dirt and filth.

Purification of Air.

Nature affords a variety of means by which air is purified, such as the diffusive power of gases, the dispersion and consequent dilution of gaseous and suspended impurities by the action of winds, the action of oxygen either in its natural condition or in its more active form of ozone, the action of rain in washing down or absorbing impurities, and the action of various chemical agents as directed and applied by man. To purify the air of dwellings and apartments, we sometimes make use of certain chemical agents known as deodorizers, disinfectants, or antiseptics, but these should never be depended upon to the neglect of cleanliness and ventilation, of which something will be said presently.

Air-purifiers, as they are called, may be arranged in three classes, to wit: solid, liquid, and gaseous. Among the solids those in more general use are *charcoal* and *lime* in some of its forms. The former, reduced to coarse powder and exposed to the air in shallow pans, is a good absorbent of sewer gas, sulphuretted hydro-

gen, and organic emanations from the sick, which latter quality has led to its frequent employment in sick-rooms and hospital wards. It may also be used with good effect in water-closets, over sinks, and as ventilating filters for sewers and cesspools. If kept dry it may be used for a long time without renewal. Dried, marly earth, finely pulverized, is also used as a deodorant, and as such possesses considerable merit, but is inferior to charcoal.

Lime in some form is largely employed as an air-purifier. Quick-lime readily absorbs moisture as well as offensive effluvia, and may be used for this purpose in damp cellars, courts, and areas. Quick-lime and slaked lime both readily absorb carbonic acid.

Sulphate of lime, known also as gypsum or plaster of Paris, with the addition of coal tar, or impure carbolic acid, is an effective deodorant for stables and manure heaps. It has the effect of absorbing and retaining the ammonia, and therefore not only purifies the air of the stable, but preserves to the manure its most valuable quality. *Carbolate of lime* has also been used for a similar purpose.

Liquid purifiers consist mostly of metallic salts in solution, among which are a solution of permanganate of potassium (Condy's Fluid), nitrate of lead (Ledoyen's Fluid), chloride of zinc (Burnett's Fluid), and solutions of the different salts of iron, copper, and zinc.

Permanganate of potassium in solution acts by parting with its oxygen, which destroys organic matter in the air with which it comes in contact, thus killing the foul odor of ill-ventilated rooms. It may be exposed in flat dishes, or cloths may be dipped in it and hung about in different parts of the room; or what is, perhaps, better, it may be used in the form of spray. Its being without odor renders it a neat and desirable article for use in the sick-room.

Nitrate of lead, although a poisonous salt, is valuable from the fact that it readily absorbs sulphuretted hydrogen, and thus rids us of a very offensive odor. Cloths may be dipped in the solution, and then exposed to the air, or some of Ledoyen's Fluid may be sprinkled about the apartment. The salts of iron, copper and zinc, in solution, with or without the addition of carbolic acid, are useful in destroying the foul odors in the air of cesspools, privies, house-drains, water-closets, street-gutters, garbage-boxes, etc. Among these the more convenient and less expensive ones are *sulphate of iron* (copperas), *sulphate of copper* (blue vitriol), and *sulphate of zinc* (white vitriol).

Other salts are used, many of them prepared from the waste of factories where these metals are manufactured into the various

articles of trade and industry. But none of these should ever be regarded as substitutes for cleanliness. Thorough cleansing of such places and things, a copious supply of water, a liberal use of lime in whitewashing the walls of cellars, courts, and areas, and adequate ventilation are, after all, the best air-purifiers.

Gaseous air-purifiers next claim our attention, and of these there are several. Owing to their diffusive power, it may be readily seen that the evolution of such gases as attack and destroy effete organic matter must constitute a powerful means of purifying the air. Those in general use are ozone, chlorine, iodine, bromine, nitrous, sulphurous, and hydrochloric acids, carbolic acid, and the fumes of tar and of acetic acid.

The activity of *ozone* in oxidizing organic matter has been previously mentioned. There are several methods of disengaging ozone; only two of the more simple methods, however, will be given here. It may be done by half immersing a stick of phosphorus in water in a wide-mouthed bottle. As the phosphorus is slowly oxidized ozone is disengaged, and its presence may be tested by a slip of paper or linen previously soaked in a solution of iodide of potassium and starch in distilled water; the proportions being one part of pure iodide of potassium, ten of starch, and 200 of water. They should be carefully dried, and when used they should be exposed to the air in such a way that the light may be excluded from them, as suspended within a box, the bottom of which has been removed. As ozone possesses the power of liberating iodine from its combination with potassium, the test-paper will show its presence by acquiring a lavender tint, varying to a deeper blue, according to the amount of ozone present; and whenever the color approaches a deep blue, the bottle containing the phosphorus should be closed with a stopper, and kept for future use. As much care and delicacy are necessary in preparing these tests, persons who are not accustomed to manipulations of the kind would do well to have them prepared by a practical chemist. Ozone is also readily formed by the action of strong sulphuric acid on potassium permanganate in the proportions of three parts of acid to two of the salt, gradually mixed. This mixture, it is said, will continue to give off ozone for several months. It has recently been stated that certain aromatic plants, such as the cherry-laurel, clove, lavender, mint, lemon, fennel, etc., and such flowers as the narcissus, heliotrope, hyacinth, mignonette, etc., develop ozone largely when exposed to the sun's rays. The same is said of such perfumes as eau-de-Cologne, oil of bergamot, essences and essential oils when exposed to the influence of air and light. If this be true—and it is supported by high authority—we

see that in the cultivation of our choice plants and flowers we are not only contributing to our pleasure, but also to our health in supplying the air with an effective purifier; and that the use of aromatic perfumes in the sick-room may contribute something more than agreeable sensations to the patient.

Chlorine is given off gradually from chloride of lime, moistened with water or with dilute sulphuric acid. It destroys organic matter in the air, and rapidly decomposes sulphuretted hydrogen and ammonium sulphide, which renders it a valuable air-purifier.

Iodine and *bromine*, when vaporized, arrest putrefaction, but as they are less diffusible than chlorine they are also less useful. The vapor of bromine is, moreover, irritating, and should be used with caution.

Nitrous and *sulphurous acids*, on account of their irritating and dangerous nature, should be used only in empty rooms, of which notice will be made presently.

Carbolic acid has become quite popular within the last ten years, and is readily vaporized by dipping cloths in a solution of the acid, and exposing them to the air. It conceals offensive odors, and is believed to arrest the putrefaction of organic matters floating in the air. It is more valuable, however, when applied with lime, or some of the metallic salts, in the disinfection of excreta, privies, sewers, cesspools, etc.

Acetic acid.—Evaporating vinegar from a hot iron is an old custom. It conceals, for the time, offensive odors, and probably destroys any excess of ammonia in the air. Air of the sick-room cannot be subjected to the influence of the more irritating gases mentioned, therefore every attention should be paid to ventilation with a view to securing an abundance of fresh air. Excreta should be treated with one of the iron or zinc solutions, and immediately removed from the room. A mixture used for this purpose by the Health Department of New York, is composed of eight ounces of sulphate of zinc, one ounce of carbolic acid, and three gallons of water. A little of this mixture, or, what is quite as good, a solution of chloride of lime, may be kept in the vessels which receive the excreta, both in the sick-room and the nursery. Chloralum may also be used for this purpose. All furniture and drapery not necessary for the patient should be removed. [Directions for the preparation of these various disinfectants will be found in Volume II.]

Disinfection of Empty Rooms.

After the removal of the patient, if the disease be of a contagious or infectious nature, the empty room should be submitted

to a thorough fumigation with chlorine, or nitrous or sulphurous acid.

Nitrous acid is readily evolved by placing a piece of copper in nitric acid, to which a little water has been added.

Sulphurous acid is developed by burning sulphur. This is best done in iron pans, placed on bricks so as to avoid any danger from fire. The sulphur is placed in the pans (one or more, according to the size of the room), and a little alcohol added in order to start the combustion. The operator, after seeing that the windows and fireplace are securely closed, applies a lighted match to the alcohol, and immediately leaves the room, closing the door after him, which should remain closed for five or six hours, that the air and articles in the room may be sufficiently exposed to the influence of the acid fumes. To thoroughly fumigate a room of 2,000 cubic feet requires four pounds of sulphur. If chlorine be used, sufficient may be evolved by adding to three pounds of chloride of lime one pound of sulphuric acid, previously diluted with four times its volume of water. As the mixture of the water and acid evolves a good deal of heat, it should be done in a strong earthenware vessel. If nitrous acid be preferred, it is readily evolved by adding to half a pound of copper turnings one pint of commercial nitric acid, previously diluted with an equal quantity of water. Whichever method may be preferred, a certain amount of caution on the part of the operator is necessary, lest some injury may be done to the lungs by the irritating gases evolved; and, therefore, when possible, the services of an experienced health officer should be secured for the purpose.

Ventilation.

Although the various purifying agencies hitherto mentioned are all valuable when properly applied, still we must not forget that air is its own best purifier, and that no method of purification, however valuable in itself, can be substituted for thorough ventilation. Ventilation, in its full significance, includes expelling from apartments all impure air, whether the result of respiration, combustion, or from whatever source, supplying in its stead an adequate amount of fresh air, and regulating the amount of moisture in the air, and the temperature of the apartment. Impurities resulting from respiration have already been sufficiently stated, but when we add to these the products of combustion, exhalation, etc., we shall be still more convinced of the importance of ventilation.

It will be remembered that combustion, like respiration, ex-

hausts the air of oxygen, and at the same time increases the amount of carbonic acid. Let us see now at what rate the air is deprived of its oxygen and poisoned with carbonic acid in the ordinary combustion of lights and fuel for domestic purposes. It is true that in the combustion of fuel for warming and culinary purposes, most of the products escape through the chimney to the external atmosphere; but this is not so with the fuel used for lighting, the products of which remain in the room and are mingled with the air we breathe. To understand the rate at which the air is rendered impure from this cause, we must know the amount of fuel used, and the amount of oxygen necessary to effect its combustion. Experiments have shown that one pound of sperm oil consumes the oxygen of 140 cubic feet of air, and that a cubic foot of coal-gas consumes the oxygen of from eight to fourteen cubic feet of air, according to the quality of the gas. It is estimated that an ordinary gas-burner vitiates the atmosphere to an extent equal to the respiration of three men.

Ventilation is divided into *natural* and *mechanical;* one consists in taking advantage of certain natural forces always in action; the other in compelling the necessary movements of air by mechanical means. The forces concerned in natural ventilation are, the diffusion of gases, wind, and the unequal pressure of two columns of air of different temperatures. It is fortunate for the human family that gases possess this diffusive power, and that their natural tendency is to escape from our houses, in spite of our bungling contrivances to keep them in and the air out. So strong is their diffusive power that neither the closest fittings of carpentry, nor even brick or stone walls, can present an impermeable barrier to their escape. We cannot depend, however, upon diffusion alone; even were it equal to the production, there are other impurities, to get rid of which we must take advantage of the other two forces, and here wind comes in as the most efficient natural ventilator.

Wind is air in motion, however gentle or violent that motion may be; and in order to avail ourselves of the benefits of its direct action as a natural ventilator, we have only to open a window. If the wind moves at the rate of a mile an hour, it will, in a very short time, change the entire air of a room without being perceptible to the occupants. But, as a light breeze moves at the rate of eight or ten miles an hour, it is necessary for our safety that such direction should be given to the in-coming air as to shield the occupants of the room from its direct influence. Various appliances have been introduced for this purpose which cannot be described here in detail, but all operating on either one of two principles: to

throw the current of air upward toward the ceiling, that it may mingle with the warm air in the upper part of the room, or to break its force by causing it to pass through the meshes of a fine screen, or by the action of a rotating ventilator in the window. Sleeping-apartments that have been occupied during the night should be exposed to the direct action of a current of air for several hours during the day. This is necessary in order that, by many and frequent renewals of air, the animal matter in the room may be destroyed. For the same reason the bedding should be daily exposed to the direct influence of air-currents. It should be an inflexible rule not to sleep with closed windows, no matter how cold the weather. The body may be protected, if necessary, at any time, by an additional blanket or quilt, but there is no protection for the lungs like pure air ; and therefore an open window and a fire-place in every sleeping-room are hygienic necessities.

The wind also acts, by blowing over the tops of chimneys, to create a current upwards through the chimney or ventilating-shaft, and thus favors the exit of foul air from the dwelling. This action may be better secured, and downward currents prevented, by surmounting the chimney or ventilating-shaft with some one of the many appliances in use for the purpose.

We make use of the third natural force whenever we kindle a fire, or increase the temperature in any way. If two tubes be made to connect the same apartment with the external atmosphere, and one of them be warmed in any way, an upward current is at once established, while a corresponding downward current takes place through the colder tube ; and this will continue as long as this difference in temperature remains. It is on this principle that a cluster of gas-lights, suspended immediately beneath an opening in the ceiling to a ventilating-shaft, as in many of our public halls, secures the egress not only of the products of combustion, but of vitiated air from all parts of the room ; and it is on the same principle that an open fire—which, by the way, is by far the most effective ventilator—secures a constant current up the chimney, while, to re-establish the lost equilibrium, air from without forces its way into the apartment through every minute opening. The only objection to an open fire is the danger of exposure to drafts of in-coming air ; and therefore we must not neglect to provide for the admission of air, so as to secure ourselves from any such danger. Special provisions for this purpose, together with the construction of houses with reference to warming and ventilation, are the subjects of another chapter.

E. H. JANES, M.D.

Hygiene—Drainage, Sewerage, and Water-Supply.

BY

JOHN W. PINKHAM, A.B., M.D.,

OF MONTCLAIR, N. J.

DRAINAGE, SEWERAGE, AND WATER-SUPPLY.

Drainage, Sewerage, and Water-Supply involve difficult and important questions in sanitary science. In this chapter these subjects will be discussed only in relation to their most obvious and practical bearings on the health of families and communities.

Owing to the fact that the terms drainage and sewerage are often used interchangeably, it will be necessary to state in the outset that the former should be employed only (as it most generally is by writers on sanitary science) to designate the removal of surface and subsoil water—what is technically called *surplus water;* while the use of the latter should be confined to the removal of slop-water and refuse matter.

Drainage.

It has long been believed that wet cellars and damp locations are prejudicial to health, but no careful study seems to have been made in regard to the subject until about the year 1860, when Dr. Bowditch, of Boston, addressed inquiries to the resident physicians in the different townships of Massachusetts concerning the probable relation existing between pulmonary consumption and soil-dampness. The result is stated in his own words, as follows: "Medical opinion in Massachusetts, as deduced from the written statements of resident physicians in 183 towns, tends strongly to prove, though perhaps not affording perfect proof of, the existence of a law in the development of consumption in Massachusetts, which law has for its central idea that dampness of the soil of any township or locality is intimately connected, and probably as cause and effect, with the prevalence of consumption in that town or locality."

A few years after this announcement by Dr. Bowditch, Dr. Buchanan, of England, by a series of very careful investigations made in the counties of Surrey, Kent, and Sussex, reduced to a "scientific certainty" what Dr. Bowditch had shown to be so

highly probable. He ascertained that "wherever the drying of the subsoil had been effected, either by the construction of drain-sewers or by special drains and deep storm-culverts, when the pipe-system was carried out, the mortality from consumption had decreased from about fifty per cent. downward. In Salisbury, for example, the death-rates from this disease had fallen 49 per hundred; in Ely, 47; in Rugby, 43; in Banbury, 41; and in thirteen other towns the rate of diminution, though not so marked, was nevertheless noteworthy. On the other hand, it also became apparent that in certain towns, such as Alnwick, Stafford, Morpeth, and Ashley, where no drying of the subsoil had been effected, there was no reduction in the consumption death-rate, even although the greatest possible progress had been achieved in the removal of filth. This was owing to the fact that in these towns impervious pipe-sewers had been laid down, without making any provision for deep subsoil drainage, the storm-water being carried off in superficial culverts. In some towns, again, such as Penzance, where the subsoil was already dry, the phthisis (consumption) death-rate remained stationary; and in others, where plans of drainage had been carried out, the sanitary advantages as regards phthisis were nullified because, as in the case of Carlisle, they were so low-lying that the subsoil was at all times more or less water-logged." *

The following general conclusions are given by Dr. Buchanan as the result of his inquiry:

"1.—Within the counties of Surrey, Kent, and Sussex, there is, broadly speaking, less phthisis among populations living on pervious (porous) soils than among populations living on impervious soils.

"2.—Within the same counties there is less phthisis among populations living on high-lying pervious soils than among populations living on low-lying pervious soils.

"3.—Within the same counties there is less phthisis among populations living on sloping impervious soils than among populations living on flat impervious soils.

"4.—The connection between soil-dampness and phthisis has been established in this inquiry: *a*, By the existence of general agreement in phthisis-mortality between districts that have common geological and topographical features of a nature to affect the water-holding quality of the soil; *b*, by the existence of general disagreement between districts that are differently circumstanced in regard of such features; and, *c*, by the discovery of pretty reg-

* See Wilson's Handbook of Hygiene, page 269.

ular concomitancy in the fluctuation of the two conditions, from much phthisis with much wetness of soil, to little phthisis with little wetness of soil.

"5.—The whole of the foregoing conclusions combine into one —which may now be affirmed generally, and not only of particular districts—that wetness of soil is a cause of phthisis (consumption) to the population living upon it."

Some writers believe that soil-dampness is the cause of many other diseases, such as intermittent and remittent fevers, rheumatic affections, neuralgia, croup, quinsy, diphtheria, pneumonia, pleurisy, bronchitis, cerebro-spinal meningitis, erysipelas, and diarrhœal diseases.

Dr. Pettenkofer, of Munich, asserts that the distribution of cholera in a country depends entirely upon certain conditions in the level of the subsoil water.

Dr. Elisha Harris found in New York city that diphtheria prevailed more extensively in damp localities, especially in the vicinity of the old obstructed watercourses, than in other parts of the city.

Dr. J. G. Pinkham, in his very carefully prepared Report to the State Board of Health, on Diphtheria, in Lynn, Mass., has designated on a map the points where cases of diphtheria have occurred during certain years, and shown that the disease prevailed to a much greater extent in regions where there were damp cellars, and especially in those localities where dampness and filth were combined.

During a practice of eleven years in a suburban town, the writer has not seen a single case of diphtheria in which soil-dampness could not be assigned as a cause. In two instances, where the disease was especially malignant, the houses were situated near water-courses, and the cellars were wet for at least eight months in the year.

It is not supposed, of course, that soil-dampness is the sole cause of the diseases above mentioned, but that it is an important factor in their causation there can be no doubt.

In the present state of our knowledge, it is impossible to say how it is that dampness of the soil produces disease. In some way, however, it furnishes one of the conditions necessary for the production of those *telluric emanations* which are so antagonistic to health.

The above considerations indicate the importance of living upon a dry soil, and make it obligatory upon any community whose territory is water-logged, either wholly or in part, to drain such territory of its surplus water.

By surplus water is meant that which is not held in the soil by capillary attraction—all that water which would run away from a quantity of wet earth placed in a barrel with holes in the bottom. Such drainage can be easily accomplished. Unglazed tiling, with joints carefully protected, laid at a depth of three or four feet, with proper inclination and a free discharge, and at suitable distances, will drain any soil, however wet, in less than twenty-four hours. To ascertain whether a given locality requires draining, let an excavation be made to the depth of three feet, and if water is found in it twenty-four hours after the heaviest rain, the locality is unfit for human habitation.

The ill-effects of a damp soil are not confined to those immediately living upon it, but extend to a considerable distance ; so that every inhabitant, whether his own location be wet or dry, should concern himself in this matter. It is pre-eminently a subject of general interest. The evils resulting from a water-logged soil rapidly increase with an increasing population, and at the same time the difficulties of drainage become greatly increased when a place becomes thickly settled. In fact, it is almost impossible in many cases, after grades are established and permanent improvements made, to accomplish, even at great expense, what in the early history of a place could be done with very little cost and labor.

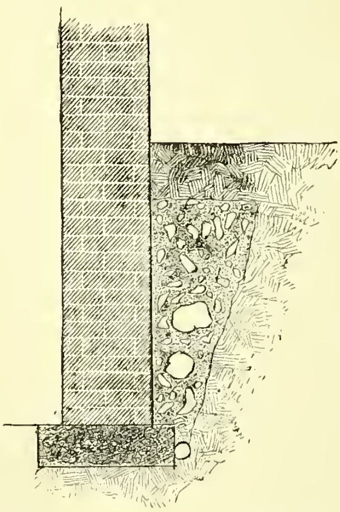


Figure 125.—Tile-drain at the bottom of a foundation-wall.

It is also important that water falling upon the roofs of houses should be promptly conducted away, and not allowed to saturate the soil around the foundations, and find its way into cellars.

The site selected for a house should be thoroughly drained to a depth at least a foot below the bottom of the cellar, and the foundation should be so constructed that the storm-water which dashes against the house, and the water which accumulates in freshets in its vicinity, may be arrested and conducted away. This can be accomplished by sinking the foundation wall a foot below the cellar bottom, placing a tile-drain outside of this, filling the excavation below the cellar-floor with concrete, building the cellar-wall of brick, and covering the outside of this wall with a layer of some material

impervious to water. It would be well to place above the drain, reaching to a point near the surface, a quantity of coarse sand or gravel, to allow the water more easy access to the drain. (See Fig. 125.) If the land be at all springy, there should be, in addition to this outer drain surrounding the foundation, several cross drains, all of which may have the same outflow. Then, if the floor be covered with a good layer of cement (some preparation of asphalt is the best), there is no doubt that the cellar at all times of the year will be perfectly dry. It should be remembered that bricks absorb water very freely, and that for this reason they should be painted or thoroughly oiled, wherever in the walls of a house or cellar they are exposed to the weather. If all dwellings could have their foundations constructed in this way, there would follow, in most places, a rapid decrease in the bills of mortality, and a corresponding increase in the health and vigor of their inhabitants. See, also, chapter on House-Building.

Sewerage.

In treating this subject I shall not confine myself within the narrow limits prescribed by the definition of the word, but shall consider the subject of waste or refuse matter in a general way, pointing out the evil consequences which result from its mismanagement, and making such suggestions of a practical nature as the space will allow.

When we speak of waste matter we mean waste *organic* matter, animal or vegetable—that which, under favorable circumstances, undergoes the process of putrefaction; it comprises the excrement of animals, solid, liquid, and gaseous—all garbage and offal, all decaying animals and vegetables, all slops from kitchen and laundry, and all waste from slaughter-houses and factories.

Organic matter in the process of degenerative change assumes forms that are exceedingly deleterious in their effects on animal life. When we consider the vast quantity of refuse matter produced by every community, and remember that, with the treatment it generally receives, it pervades earth, air, and water, finding its way to the system with the food we eat, the water we drink, and the air we breathe; when we remember, in addition to this, that many of the diseases vhich result from it are highly contagious, spreading like wildfire and producing widespread destruction in whatever territory they invade, the statement that refuse matter or filth has been the great scourge of the human race will no longer be received with incredulity.

The plague, cholera, typhoid and typhus fevers, and dysentery, are among the diseases which hold such relation to filth and its emanations that we have the strongest reasons for believing that without the latter the former would cease to exist.

The plague, which in some centuries has been more destructive to human life than war, has always had its origin in filthy and overcrowded cities, or in localities exposed to pestilent effluvia from decaying animal and vegetable substances. Thucydides states that during the great plague of Athens, which occurred in 430 B. C., the city was greatly overcrowded, most of the population having taken refuge within the walls in consequence of the war. Dr. Laycock says of the plague which occurred in the city of York, in 1604: "There were wide, stagnant moats, no drainage, narrow streets, and filthy, open channels, the tide flowing above the city, and leaving sludge and mud on the deep banks of the river, and exposing the mouths of the sewers." He reports also "that the plague in each of its visitations broke out in an abominably filthy place, called Hagworm's Nest, and that, curiously enough, the cholera in 1832 broke out first in the same place, and that each of these diseases progressed in much the same manner through the city, marking the badly drained district by its course."

The epidemics of the plague, which have so often visited Egypt, always are at the worst in the spring, "at which time south winds prevail loaded with putrid emanations from animal and vegetable substances in the lakes formed by the retiring waters of the Nile."

The connection between filth and the origin and spread of cholera is even more marked.

Typhoid fever is a disease of alarming fatality, which prevails to a greater or less extent at all times in nearly all countries. No class is exempt from its ravages; it attacks alike the rich and poor in city and country. Sir William Gull says that in England alone typhoid fever kills 17,000 persons a year. This disease also holds an important relation to decomposing animal and vegetable matter. Just what that relation is, no one is yet able to state with certainty; but it seems highly probable, and to many, certain, that refuse matter, especially that variety called *excrementitious*, furnishes not only the means of communicating the disease, but also appropriate conditions for the propagation of the specific germs which are necessary for its production. Sir William Gull makes the following statement: "The origination of the disease is, somehow or another, connected with drainage. It has, therefore, been called the filth fever; hence, to get rid of the filth is to get rid of

the fever. It seems as if this really is so, for Millbank Prison was infested with typhoid and dysentery ; but now the water-supply has been changed, and the drainage attended to, and these diseases have almost entirely disappeared. No one can approach a case of typhoid fever without paying some attention to hygiene. It is no use tinkering with the disease if one does not try to prevent it, and it no doubt may be prevented. The theory is, that it is connected with germs which get into the blood. We know little about these germs, but have reason to believe that the air is full of them. There is an idea that they are imbibed by drinking water, and that they increase and multiply within the body. Although this has not been demonstrated, yet it is a good working theory." These remarks apply equally to the disease mentioned above.

Dr. T. Wrigley Grimshaw, Senior Physician to the Fever Hospital, Dublin, remarks as follows : "The exciting cause of enteric fever is now well known to be connected with the introduction of decomposing fæcal matter into the system by the mouth. What may be the exact product of decomposition which gives rise to this formidable disease, has not yet been ascertained. It has, however, been satisfactorily proved that this principle, be it what it may, can enter the system in the form of contaminated food and drink, or as a miasma in the air itself. In the lecture before alluded to, I have drawn attention to the fact that enteric fever has been propagated by means of water tainted by sewage, by milk adulterated with animal matter, and, as a matter of course, by fæcal matter. The recent illness of H. R. H., the Prince of Wales, has been justly attributed to fæcal miasma. Many examples of the connection of this disease with the drinking of water impregnated with sewage matter, are to be found in the reports of the Medical Officers of the Privy Council for England."

Waste organic matter finds its way into the system by all its avenues of approach : it enters in solid, liquid, and gaseous forms; it saturates the soil, soaks into wells, pervades the air in the form of sewer-gas and exhalations from privies, cesspools, and filth-sodden soil, and thus pollutes the air of our dwelling-houses, factories and stores, and becomes mingled with our drinking-water and food. In this way it enters the system, causing, as we have seen, under favorable circumstances, the most fatal diseases. Falling short of this it works such damage to the general health, such a lowering of vitality, such a diminution of energy, that the individual subjected to its influence becomes unable to resist the wear and tear and exposure, which is the lot of all in the great "struggle for life," and either becomes a hopeless invalid, or works on painfully and ineffectually, until some weakened organ

refuses to perform its function, and death puts an end to a life of suffering.

The question now arises, "How can we protect ourselves against this all-pervading and deadly foe?" The answer, made in a general way, is simple.

It may, in fact, be summed up in one word—CLEANLINESS—clean air, clean water, clean food, clean soil, clean houses. When, however, we come to the consideration of the means necessary to secure this universal cleanliness, we find many difficulties in the way, some of which, as society is now constituted, seem almost insuperable. Chief among these difficulties is the almost universal ignorance regarding the preservation of health, which is found among all classes, and the consequent indifference which renders it, in most cases, impossible to obtain that co-operation which is absolutely necessary to the carrying out, perfectly, of any proposed plan. Then there are mechanical difficulties, especially in large cities, which tax the skill of the best engineers. For a discussion of these the reader is referred to works on Hygiene and Sanitary Engineering.*

Water-Closets.

In houses where there are water-closets, the great danger is from *sewer-gas*. This gas is generated in great quantity in sewers and cesspools, and at times forces its way through traps and imperfect pipes into dwelling-houses. To avoid this evil four things are necessary:

1. Effective traps.
2. Ventilated waste- and soil-pipes.
3. Thorough plumbing work.
4. A light and well ventilated room for the water-closet, so situated that it can be entirely shut off from the rest of the house.

It is a question whether stationary wash-basins in bed-rooms should ever be tolerated. It is doubtful whether any precaution will, under all circumstances of atmospheric pressure, render the ingress of sewer-gas impossible, and even a small quantity in a sleeping-room cannot be other than extremely injurious. Wherever these basins exist, if there is the slightest reason for suspecting them of giving passage to sewer-gas, the waste-pipes should

* See A Treatise on Hygiene and Public Health, edited by Dr. A. H. Buck; Parkes' Practical Hygiene; Treatment and Utilization of Sewage, by W. H. Corfield; Wilson's Hand-book of Hygiene; and also the writings of Col. G. E. Waring, of Newport, R. I.

be severed, and the sewer end hermetically sealed. The dressing-rooms or closets having such basins should be so ventilated, that the current of air will be towards them and outward, instead of *from* them towards the other apartments. It must be remembered that the warm air of dwelling-houses passing constantly up chimneys and towards attics, exercises an aspirating force upon openings, those into sewers not excepted. This force acts in conjunction with the pressure from behind, and must be taken into the account in the construction of traps and ventilators.

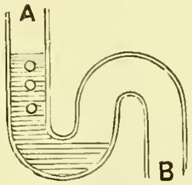


FIG. 126.

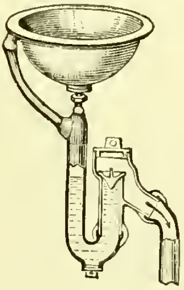


FIG. 127.

FIGURE 126.—Showing how the fluid in a trap may be forced up by the presence of gas or air on the side towards the sewer, and admit the passage of sewer-gas.

FIGURE 127.—A trap recently devised by Mr. G. E. Waring, of Newport, R. I., in which the trap is deeper than is ordinarily the case, and is also provided with a close-fitting valve, which, while it offers no impediment to the outflow of water, is calculated to prevent the return of sewer-gas.

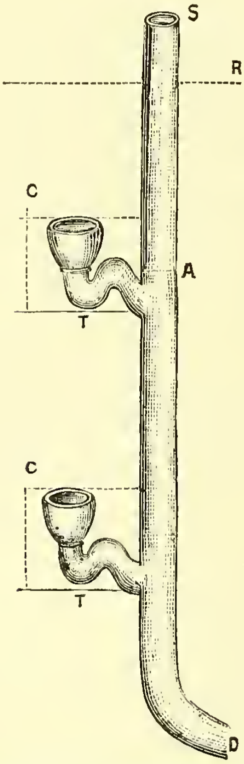
The following quotation from Dr. Parkes seems to contain all necessary precautions concerning traps :

"Supposing, of course, it is properly laid, a trap is efficient, if water stands in it to the height of three-quarters of an inch above openings, if water passes through it sufficiently often, and with force enough to clear out the receptacle and renew the water in it. But traps are often ineffective : 1st, From bad laying, which is a very common fault ; 2d, from the water getting thoroughly impregnated with sewer-effluvia, so that there is escape of effluvia from the water on the house side ; 3d, from the water passing too seldom along the pipe, so that the trap is either dry or clogged; 4th, from the pipe being too small (two to three inches only), and "running full," which will sometimes suck the water out of the trap. This usually occurs in the following way, as frequently seen in sink-traps : the pipe beyond the trap has perhaps a very great and sudden fall, and when it is full of water it acts like a siphon, and sucks all the water out of the trap ; to avoid this, the pipe

should be large enough to prevent its running full, or the trap should be of larger calibre than the rest of the pipe."

The soil- and waste-pipes in every house should be supplied with one or more ventilating-shafts. These should be so arranged as to give free exit to any gases which may under any circumstances exert an upward pressure upon the fluid in the traps.

The simplest way to accomplish this is to use the soil-pipe itself as a ventilating shaft, connecting with this the secondary pipe, as shown in the adjoining figure.*



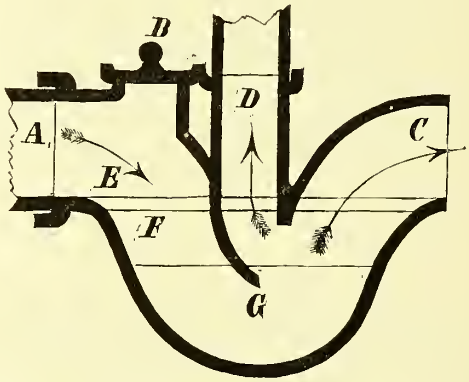


FIGURE 129.—Ventilating-trap.* Water, etc., enters at A, and is discharged at C, the trap remaining full to the line E. When the pressure at C is greater than at A, and the water is depressed to the line F, or becomes saturated with sewer-gas, the latter finds an exit at D, and escapes into the ventilating-pipe without passing back through it. When the water in the trap has been lessened by evaporation, it is necessary for its level to fall below the line G before gas can escape at A.

FIGURE 128.—A, D, the soil-pipe extended to S, above the line of the roof, R; C, C, water-closets having traps T, T, which are wrongly represented in the illustration, since they should be so made that when the lower bend is full of water the upper angle or curve of the trap should come a short distance below its surface, as shown in the figures 126 and 132.

Where the construction of a house is such that this method cannot be employed, a ventilated trap should be inserted where the soil-pipe joins the house-sewer, and a ventilating-pipe carried from

* Dangers to Health in Our Own Houses, by T. Pridgin Teale, M.A.

this to the top of the house. The soil-pipe between the trap and the water-closet should also be ventilated by a tube connecting with the one just described, and passing independently to the top of the house. Such a trap is represented in Figure 129. Care should be taken that the ventilating-shaft terminates at a point where the sewer-gas will not be drawn into windows. No over-

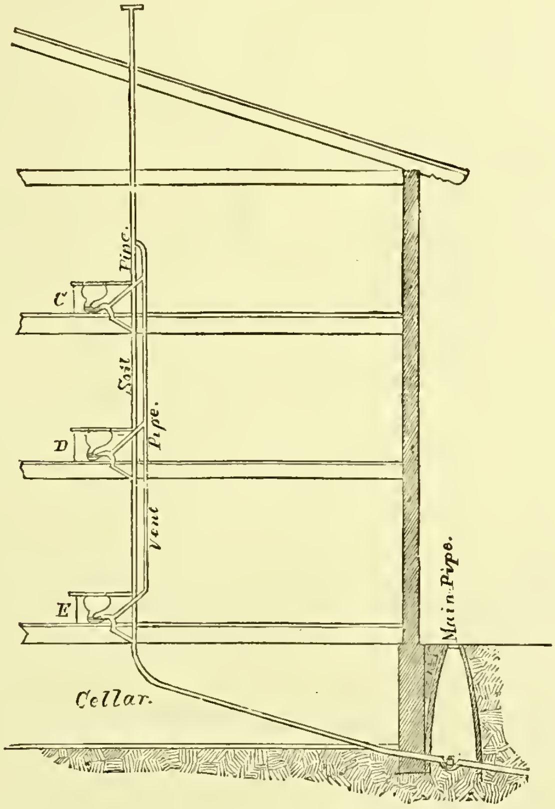


FIGURE 130.—Vent-pipe connected with the traps of water-closets C, D, and E.*

flow-pipe or leader should be allowed to empty into this shaft, for it is during a rain, when the sewers are flushed, that the greatest demand is made on the shaft as a means of exit for the sewer-gas.

Figure 130 shows a method which has been suggested of securing apartments from the invasion of sewer-gas, and likewise of

* This trap is manufactured by Stewart & Co., 269 Pearl Street, New York.

preventing the flow of water down the soil-pipe from sucking the water out of the traps of the water-closets.

Thorough plumbing work includes the selection of a good water-closet. In this matter cost should not be allowed to influence one. Figure 131 represents a water-closet which is one of the best. It is made of earthenware, and is constructed with special reference to cleanliness and ventilation.

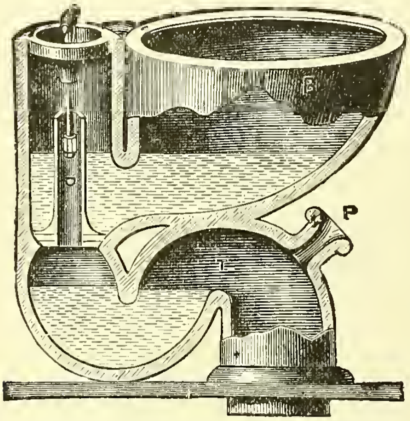


FIGURE 131.—Water-closet having an ∽-shaped trap instead of a dumping-pan, and a plug-valve which forms, also, an overflow-pipe. At P is an aperture to receive the water from a wash-basin or bath-tub. (Jennings' Patent.)

In places where there is an abundant and constant water-supply, there is no method which so promptly, so effectually, and so cheaply removes refuse matter and slops from a house as the water-carriage system, which has just been described. The objection to it lies in the difficulty connected with the final disposition of the sewage after its discharge into cesspools and sewers.

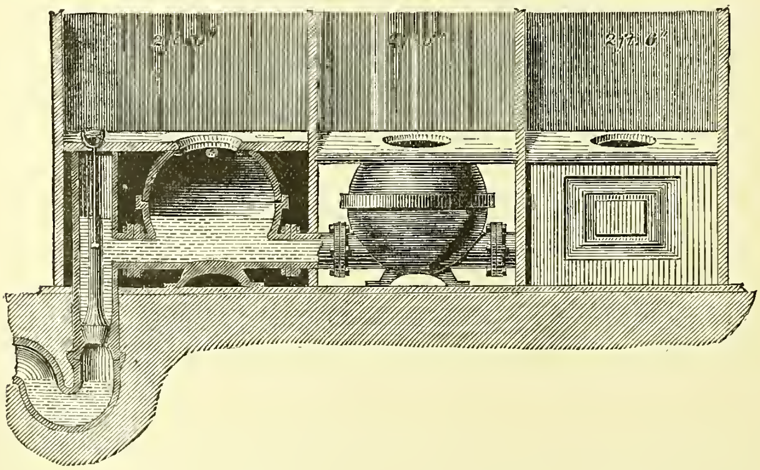


FIGURE 132.—A "latrine" adapted for use in schools, hospitals, manufactories, etc., where there is a limited water-supply, or where more complicated water-closets are not desirable. By raising the valve at the left the contents of the latrine flows suddenly out and flushes the sewer-pipe. A water-trap prevents the escape of gas from the sewer into the room. (Jennings' Patent.)

House-Sewers.

The conduit which connects the waste- and soil-pipes with the street-sewer is called the *house-sewer*. This should be of ample size, with sufficient descent, and as straight as possible. It should be made of glazed earthen-ware, laid on a firm bed, with the joinings thoroughly secured with cement. At certain points there should be placed lengths of *access-pipe* * to facilitate the process of cleaning in case the sewer becomes choked. When it becomes necessary that this sewer-pipe should cross a cellar, it should either be made of iron and allowed to rest upon the cellar-bottom, or of earthen-ware placed below the cellar-bottom, and thoroughly puddled in cement.

Privies.

The old-fashioned privy is an unmitigated nuisance; nothing worse to accomplish its purpose could well be devised. It removes neither the offensiveness nor the danger of excremental matter. It allows filth to saturate the soil and pollute the air. In its place should be substituted some one of the dry methods, so-called. One described in the Report of the State Board of Health of Massachusetts for 1876, page 181, seems so perfect and so easy to manage, that it will be given in full.

"The things to be sought are:

"1.—Ease and inoffensiveness in removing the excrement.

"2.—Security against its being absorbed by the material of the receptacle in which it is temporarily retained, or by the adjacent soil.

"3.—Security against offence.

"4.—Economy.

"In the second report of the medical officer of the Privy Council, England, 1874, is a paper by J. Netton Radcliffe, on various ways of excrement removal in use in Great Britain, which supplies a deal of valuable practical information, and from which several of the accompanying illustrations are borrowed. In all of them it will be observed that the receptacles are small, made of impervious material, easily emptied or removed, and cheap. It is the practice to add to their contents the family coal-ashes, either at every time of using or at short intervals. The largest is emptied

* These are pipes made in sections, so that when necessary one side can be removed in order to give free access to their cavity.

as often as once a week, the smallest once a day. No slops from chamber or kitchen are allowed to be thrown in. By the adoption of some one of these methods, several large towns and cities in England and Scotland have rid themselves of most dangerous and disgusting nuisances in their most densely settled parts, substituting for them an arrangement at once more decent, cleanly, convenient, and economical.

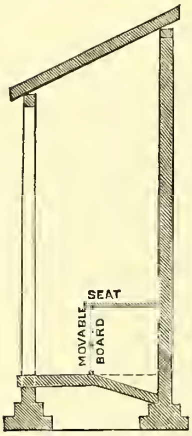


FIGURE 133.

"The privy used in Hull, here shown, is the simplest of all, and occupies the least space. The floor of the receptacle is of impervious material. Ashes and the dry refuse of the house are thrown down the seat, making with the excrement a dry, inoffensive mass, which is removed once a week with a spade, by taking out the movable board."

The Rochdale "pail-closet" system has been in use since 1868, and was thoroughly inspected and approved by Mr. Radcliffe in 1869. In 1874 he again inspected it, and gave it his unqualified approval. It

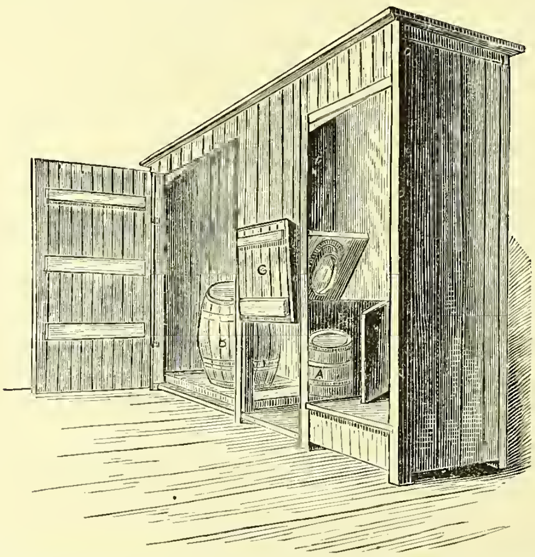


FIGURE 134.—A Rochdale pail-closet. The door which is used to close the entrance to the closet proper is not shown. A, "pail;" B, receptacle for ashes; C, door through which the "pail" can be taken out when it becomes necessary to empty it; D, the seat, hinged to partition, and raised so as to show a downward projecting flange which serves to prevent urine, etc., escaping between the bottom of the seat and the top of the "pail." The front of the seat is also hung on hinges, and may, if needed, be turned aside, as shown in the figure.

consists of a closet (out of doors) of strong and simple construction, beneath the seat of which is placed a "pail" made from

half a kerosene barrel, and capable of holding one hundred pounds; but in fact the average weight of its contents after a week's use by an ordinary family proved to be forty-one pounds. This is removed weekly, and an empty and disinfected "pail" is substituted. In the case of very large families, or of workshops, the removal is made twice or thrice a week. At the time of removal, a tightly fitting metal lid is placed upon the pail. "The process of removal is quite inoffensive," and is *systematically performed.*

The population of Rochdale in 1871 was 67,754; inhabited houses, 13,938, of which 2,944 were fitted with "pail-closets," used by 11,770 persons. In 1874 the number of houses so fitted was 7,287, used by 43,500 persons, when Mr. Radcliffe reported essentially as follows: "That the system of removal had been thoroughly approved by all who had had experience of it; and that it had not failed under the most varied circumstances, having proved equally efficacious in the highly-rented house with its own closet, in the lodging-house where great numbers were accommodated, and in the factory and workshop.

There would seem to be every reason why the law should require all factories, tenements, and boarding-houses, not furnished with a satisfactory system of water-closets, to adopt some modification of this plan. At present many factories whose operatives are numbered by scores and hundreds, have privies overhanging the streams which furnish power. This is *water-carriage* indeed! carrying, in many cases, the most dangerous and disgusting form of pollution to spoil the stream below."

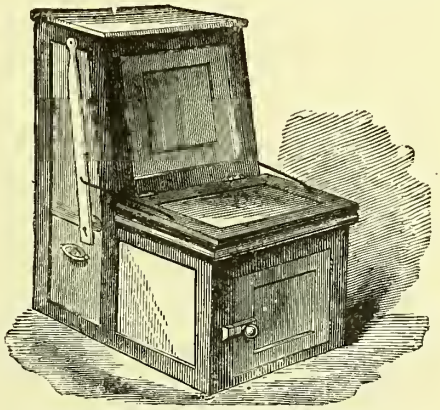


FIGURE 135.—The "Wakefield" earth-closet, in which each time that the lid is closed a small quantity of dry earth or ashes is dropped into the receiving vessel from the reservoir in the rear, so as to cover and disinfect the fœcal matter deposited in the closet.

The dry earth system has been thoroughly tested in England, and among the English inhabitants of India. In some instances it has given entire satisfaction, while in others it has proved a failure. Its successful use requires that the earth employed should be perfectly dry, and that intelligent supervision be exercised. If employed carelessly, it soon becomes a nuisance. As a general thing, the earth-closet should not be placed in the house, but in some adjoining building.

This method is well suited to farm-houses and country villages, where earth is abundant and where the product can be easily and profitably utilized. The principle on which it acts is that earth is the natural deodorizer and disinfectant of excremental matter. All the facts which have been published concerning this system go to show that when it is carried out in all its details, it accomplishes very successfully the two most important objects to be attained in any system of excrement-removal, viz.: its removal without offence or danger to health, and in such a form that it can be profitably applied to the soil as manure. This system is especially suited to the wants of jails, hospitals, and camps, where strict supervision can at all times be exercised.

For a full discussion of this subject, see Buck's "Treatise on Hygiene and Public Health," Corfield's "Treatment and Utilization of Sewage" and "Parkes' Practical Hygiene."

Cesspools.

In places where there is no system of sewerage, some form of cesspool becomes necessary in connection with all houses which are provided with the modern conveniences of hot and cold water and water-closets.

In the outset it should be stated that the surplus water, *i. e.*, the overflow from tanks and cisterns, and the surplus roof-water should always be conducted away from a house by itself, not being allowed to mingle with any waste whatever, and that the slop-water (by which is meant the laundry and kitchen waste-water) should be kept by itself, and treated apart from the excremental waste.

The cesspool into which the water-closet discharges should be made absolutely water-tight, and should be placed at some point to which easy access can be had for the purpose of emptying it of its contents. This cesspool should be ventilated, and, when it is within a hundred feet of the house, this should be accomplished by means of a shaft which will conduct the sewer-gas to a height of twenty or thirty feet from the ground.

This cesspool requires no overflow-pipe, and the cement which lines it should be made of asphalt and sand, as excremental matter will in time cause the disintegration of ordinary cement. When it is full it should, if possible, be emptied by some one of the odorless methods which are employed with such success in many cities. The apparatus used is a very simple and cheap one, consisting of an air-pump which exhausts the air from a barrel, and some tubing for connecting the barrel on one side with the cesspool, and on the other with the pump. As the air is pumped from the barrel, liquid from the cesspool flows in and fills it. To pre-

vent the escape of gases mixed with the air through the pump, an apparatus is employed which causes their destruction, and com-

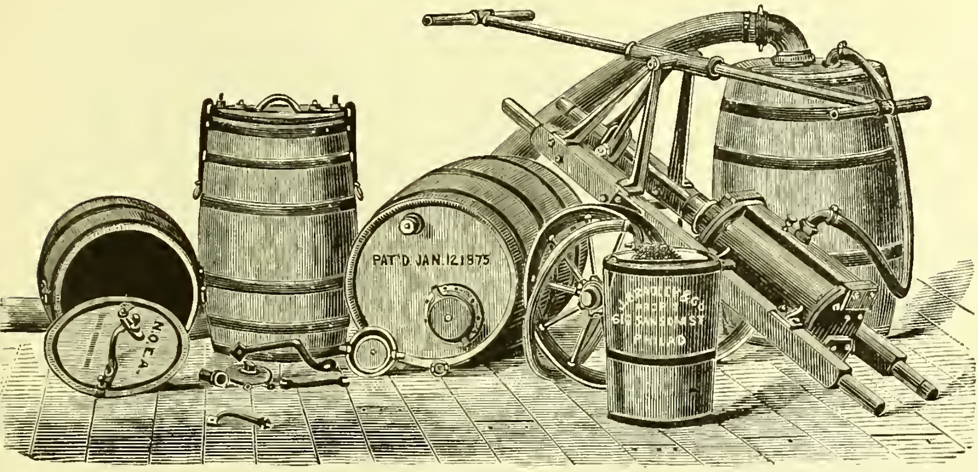


FIGURE 136.—Apparatus used for removing the contents of cesspools and privies without permitting the escape of gases.

pletely accomplishes the disinfection of the air. In this shape sewage can be transported any distance without offence, and is very valuable as a fertilizer.

Slop-water, on account of its great bulk and small value, should be treated in a different manner from the above. It should first be conducted through a carefully laid sewer-pipe, into a water-tight reservoir (Fig. 137, A), where a large portion of the solid

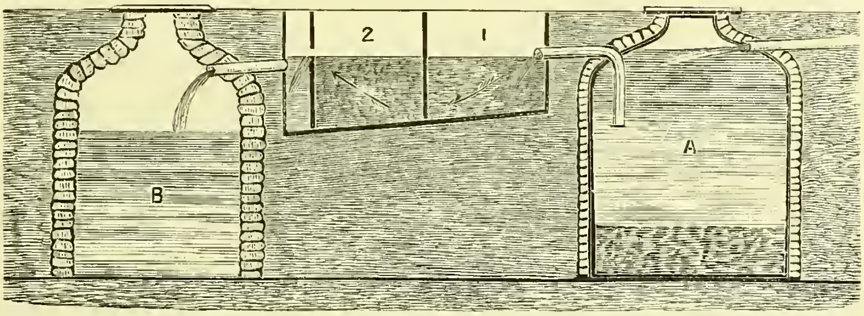


FIGURE 137.—Cesspool for slop-water: A, first reservoir; B, second reservoir; 1, 2, intermediate filters.

matter will fall to the bottom, while a small portion of fatty matter will rise to the top. The figure shows how a bent pipe may be arranged, so as to conduct the middle stratum of comparatively

clear liquid to the filters 1 and 2. Having passed through these filters, the liquid may be conducted into the soakage cesspool B, or it may safely be allowed to pass into a brook or river the water of which is not used for domestic purposes.

The filters should be so made that the water which runs off will be clear and odorless. The compartments may be made of pine plank, tongued and grooved, and carefully fitted together. The first partition should have holes near the bottom, and the second near the top. The course of the liquid through the filter is

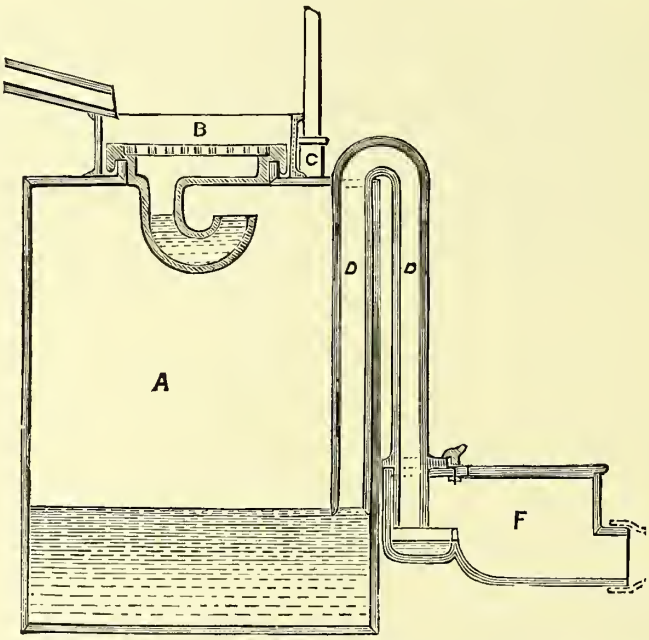


FIGURE 138.—A flushing-tank for converting a small and dribbling stream of slop-water into a sudden rush of 20 or 30 gallons, thereby scouring the drain-pipes and preventing the accumulation of sediment such as would occur when the amount of fluid passing is small and its flow is slow. A, the reservoir in which the slop-water accumulates until it rises to the bend of the siphon D, D; B, a grating provided with a water-trap, which prevents the escape of gases from the reservoir, and a flange about its outer edge which helps to form a water-joint; C, a ventilating-pipe, which is intended to extend above the top of the house; F, chamber connecting the tank with the sewer-pipe, and capable of being turned in any direction. The reservoir A is carried below the level of the siphon, in order that solid sediments may accumulate and be removed occasionally through the opening at B. (Jennings' Patent.)

indicated by the arrows. The filter may be made of gravel, coal-ashes, and finely broken charcoal in equal parts, and it must be removed when it becomes so saturated with organic matter that the effluent water is in the least offensive. The saturated filtering material will be found useful for fertilizing purposes.

When it is possible to locate the cesspool at a long distance

from the house and well, the filter may be dispensed with, and the two cesspools connected by a pipe, as shown on the foregoing page.

The objections to a single soakage cesspool are obvious ; the ground in its vicinity becomes saturated with filth, and in a short time its sides become so coated with solid matter that fluids cannot pass through them. Then it begins to overflow, and the discharged liquid becomes a nuisance.

A disgusting spectacle frequently seen in American villages and suburban towns is the slop-water sewage, which is allowed to discharge itself into the street gutters, to fester in the sun and evolve its pestilent effluvium under the very nostrils of the passers-by.

Clean Soil.

The importance of keeping the soil in the vicinity of houses and wells free from filth will be appreciated when it is remembered that the ground-air, *i. e.*, the air which fills the spaces between the particles of earth, is subject to the same laws, so far as its motion is concerned, as is the air above ground ; that there is a tendency on the part of air to move towards and into a house on account of the heat, which causes an upward current through the chimneys and roof, and that more or less of this ground air is drawn into the cellar, and passes upward into the apartments above. See Fig. 139.) Ground-air, when uncontaminated, is not to be recommended for breathing purposes, as it contains a large amount of carbonic acid ; but when it passes through filth-sodden soil, and becomes loaded with an additional freight of poison, it works dire mischief to those who are obliged to breathe it. It is in this way that those mysterious " visitations " of fever have their origin, which in time past has been so unaccountable. In nearly every section of our country there is the utmost carelessness about the disposition of refuse matter. The cesspool or privy is near the house and well, and the slops are frequently removed no farther from the house than the length of a "sink-spout." (See Fig. 139.) Of course the ground in the vicinity, and the very foundation of the house in time become saturated with filth.

In addition to this, in the Northern States at least, as winter approaches, the house is "banked up," as it is called (a practice which cuts off all ventilation for the cellar), the cellar is made the store-house for vegetables and fruit, which decay more or less during the season, the fires are kindled, and a current of poisoned air commences to ascend from the cellar, which does not cease until spring puts out the fires and takes down the "banking." No

wonder that their homes are visited by the spectres of disease; that consumption and fever, and diphtheria, attended by a cohort of minor ills, startle so many families with their dreaded presence.

A case illustrating the diffusion of gases under ground is mentioned in the report of Mr. Child, officer of health for certain districts in Oxfordshire, England:

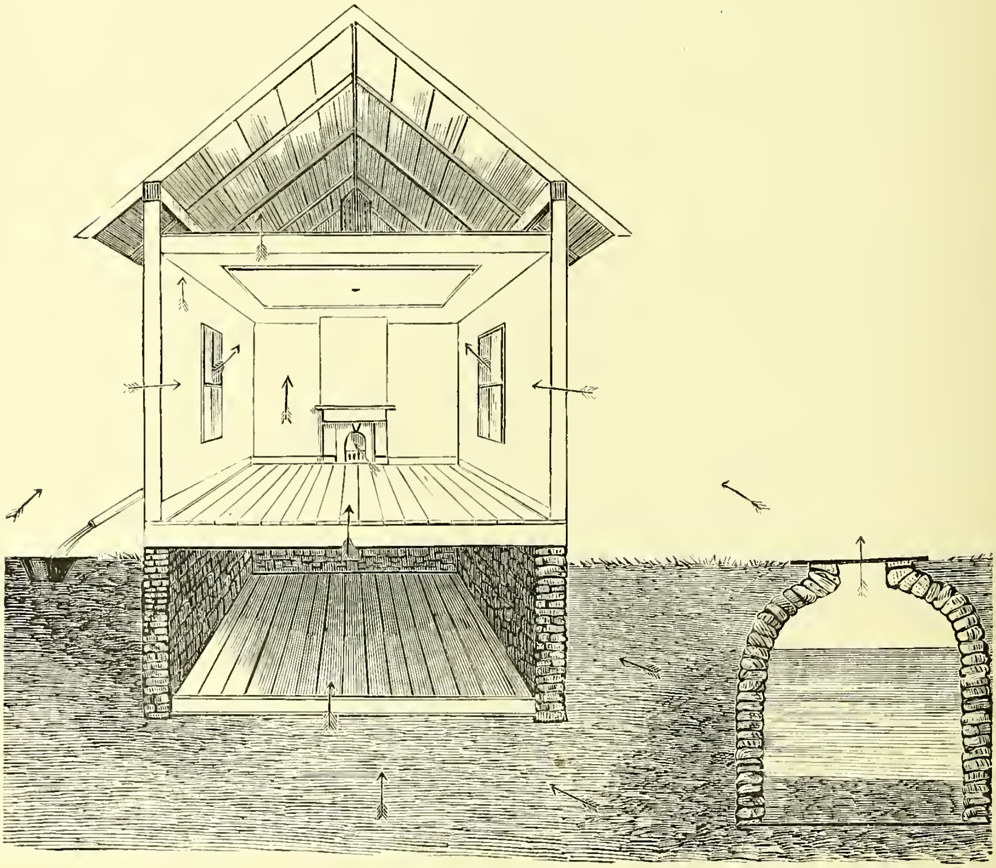


FIGURE 139.—Diagram illustrating the passage of bad air from cesspools and slop-drains into the cellar and apartments of an adjacent house.

"In consequence of the escape of the contents of a barrel of petroleum or benzoline, which had been buried in an orchard, a circuit of wells sixty feet below, and 250 or 300 yards, distant became so affected that the occupants of fifteen houses, containing eighty-two inhabitants, were for ten days unable to use the water for drinking or cooking. The cattle of one of the proprietors, more-

over, refused to drink at the spring where they were accustomed to drink. Had this soakage been sewage instead of petroleum, who can doubt that the result might have been wholesale water-poisoning and an outbreak of typhoid fever ?"

On farms and large places where horses and cattle are kept, the waste matter of every kind should be added to the compost-heap. A method employed by Dr. E. J. Dunning, of Lenox, Mass., is illustrated in the figure below.

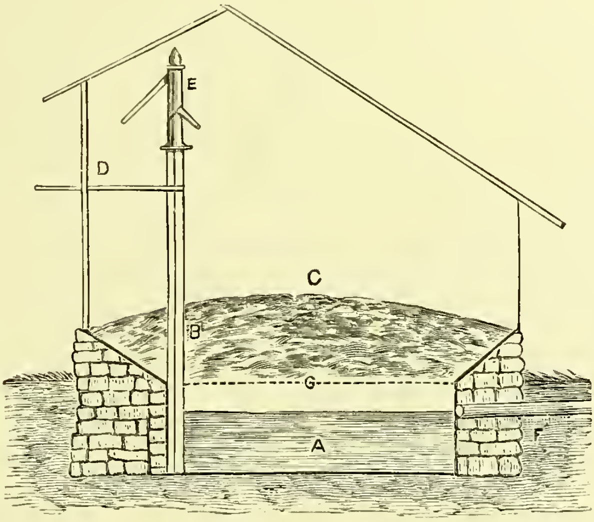


FIGURE 140.—A, reservoir; B, pump-box; C, manure-heap; D, platform from which the pump (E) is worked; F, sewer-pipe from house; G, perforated floor.

In the barn-yard is constructed the water-tight reservoir A, into which all the refuse from the house is conducted through the sewer-pipe F. The liquid sewage is pumped from the reservoir and scattered over the waste from the barn, which is thrown upon the perforated floor G. This apparatus should be located at least 200 feet from the house. It should be covered with a roof, the sides being left open, so that the process of evaporation may go on as rapidly as possible. In this way the sewage from the house becomes so diminished in bulk, and altered in constitution, that it can be applied to the land without difficulty. When the barn is situated above the house, the reservoir must be placed near the latter, and constructed as a tight cesspool, the contents of which must be forced to the compost-heap with a force-pump.

Water-Supply.

Among the conditions of health in a community, there is none more imperative than an abundant supply of *pure water*.

Whatever the source of the water may be, whether from lakes, ponds or rivers, from wells, springs or cisterns, it should be pure —we do not mean *absolutely* pure, for such water does not exist. All water contains a certain amount of mineral matter in solution, together with carbonic acid, oxygen, and a small amount of organic matter. These are derived from the air through which it falls, and from the earth over which it flows and through which it percolates. A small quantity of organic matter of *vegetable origin* (from one to three grains to the gallon) does not render water unwholesome.

Dr. Letheby, from investigations made in sixty-five English and Scotch towns, came to the conclusion that a certain amount of the earthy salts (from five to twenty grains to the gallon), is necessary to render water in the *highest degree* wholesome. An amount of saline matter exceeding thirty-five grains to the gallon is not recommended for domestic use. An excess of the lime and magnesia salts is, in certain regions, thought to be the cause of the goitre and cretinism which are endemic there.

Organic matter of *animal* origin, especially that which is excremental, is the great source of unwholesomeness in water. In places which are thickly populated, it is extremely difficult to obtain a water-supply in which sewage has not been mingled.

When organic matter is discharged into rivers and lakes, it becomes rapidly diluted and oxidized. The nitrates, nitrites and ammonia which are the products of this oxidation are not considered deleterious in their effects ; their presence, however, shows that the water which contains them has *at some time* been contaminated with sewage. There is a very grave question whether there may not be in such water *germs of disease*, so highly organized that they will resist the oxidizing process, retaining their integrity and power for mischief, even when the water which contains them responds favorably to chemical and microscopical tests. It is a significant fact that the experiments which have resulted in the approval of the Thames and other polluted waters have always been of a character that could lead to no other than a negative result. Chemical tests detect nothing—the microscope detects nothing—hence, the water is wholesome. This is the argument, but the conclusion is a *non sequitur*.

It must be remembered that, in regard to certain diseases, the

germ theory is supported by the highest scientific authority, and that the *germs* have never been detected even under the most favorable circumstances. In the present state of our knowledge it would seem safest not to depend too implicitly on the oxidizing process, but to guard with the utmost vigilance the sources of our water-supply, and to have them carefully protected from contamination with excremental waste. [See also chapter on Acute Infectious Diseases.] Dr. C. F. Chandler, although he seems to agree with the conclusions of Dr. Letheby and others in regard to the Thames water that it is perfectly wholesome, nevertheless mentions, in his "Report upon the Sanitary Chemistry of Waters," the following cases :

"At Exeter, England, in 1832, one thousand deaths occurred from cholera. A purer supply of water was then introduced from a locality two miles higher up the river, above the point at which it received the sewage of the town. When the cholera again invaded the city in 1849, only forty-four cases occurred, and in the cholera season of 1854 there was hardly a case.

"In London, in 1854, the water supplied by the Southwark Company contained much sewage, while that supplied by the Lambeth Company was very pure. Both companies had pipes in the same streets, supplying water indiscriminately on both sides. Among those who used the Southwark water the deaths amounted to one hundred and thirty in 10,000, while among those who drank the Lambeth water, they amounted to only thirty-seven in 10,000 persons ; 2,500 persons were destroyed by the Southwark water in one season. On the previous visitation of 1848–49, the case was the reverse. The deaths from the Lambeth amounted to one hundred and twenty-five, while those from the Southwark amounted to one hundred and eighteen in 10,000. At that time the Lambeth Company took their water from a point lower down the river."

In Milbank Prison, in England, a remarkable instance occurred of the abolition of diseases to which the inmates had been very liable by a change in the water-supply. For many years the water used was derived from the Thames river, and although during that period there were numerous epidemics of fever, diarrhœa, and dysentery, and many of the most eminent physicians of London were consulted in regard to the probable cause, and although, in the course of the examinations, the precaution was taken to filter carefully the water used, it was not until an artesian well was sunk and an entire change was made in the source of supply, that the condition of the prisoners was much benefited. For many years it was thought that the confinement and discipline inseparable from prison-life had something to do with the production

of the unhealthfulness, and the foul odor from the Thames river adjoining was likewise blamed in no small degree as a factor in the causation. After the change had been made, however, in the source of water-supply, the prisoners became as healthy as any population similarly situated, and in spite of the persistence of the Thames odor, the discipline and confinement. The physician of the prison, in his annual report written in 1871, stated that the prisoners had continued to be free from every form of disease which could call the sanitary arrangement in question—"as free as if the prison occupied the healthiest site in the kingdom." The report furthermore contained the following conclusions :

"1.—That the extinction of typhoid fever and other diseases of the same class is quite within the range of practicability.

"2.—That the extinction of one class of zymotic diseases is not necessarily followed by zymotic diseases of a different class. For example : it is supposed that the increased prevalence of scarlatina and measles of late years is due to the partial displacement of small-pox by vaccination. The case of Milbank shows that it is practicable to protect a community against every kind of zymotic disease. Ignorance of sanitary science is the great obstacle to the extension of this protection to the free population.

"3.—That since some of the ablest physicians in London failed for many years to detect the true cause of the unhealthiness of Milbank prison, and assigned causes for it which later experience has found to be unconnected with it, the probability is that a similar error is frequently made elsewhere, and that the prevalence of some zymotic diseases is ascribed to locality, malaria, heat, cold, variations of temperature, moral depression, and other intangible influences, which would be entirely removed by the general disuse of impure water.

"4.—That as it required long years of observation to establish the noxious influence of Thames water in Milbank, even when well filtered, under conditions very favorable for detection, we should be cautious in accepting the opinion, based on the results of chemical analysis, that the use of that water by the population of London is free from danger." *

Several epidemics of typhoid fever have been traced to the use of milk contaminated with impure water. The small amount of water left after washing the milk-cans has, in one instance at least, been sufficient to produce an epidemic of typhoid.

* Surgeon-Major De Renzy, in the *Lancet*, June 15, 1872.

Wells and Cisterns.

Notwithstanding the achievements of engineering skill, which have supplied to nearly all large cities, and to many small ones, an abundance of water from a distant and selected source, the majority of the human race (as they always have done, and in all probability will continue to do) obtain their water for domestic uses from wells and cisterns.

An aqueduct system of water-supply makes absolutely necessary a system of sewerage, on account of the enormous increase of liquid sewage, and can only be adopted with safety in places having a water-front suitable for the discharge of sewers. It seems probable, therefore, that all places, whether large or small, which are not situated on the ocean, or on some large river or lake, must continue to look to wells and cisterns for their water-supply.

Until very recently, it seems not to have been suspected that wells and cisterns could furnish water deleterious in its effects, except in some very marked cases, and then they were supposed to be poisoned by some enemy. It was not deemed possible that water which bubbled from the earth, or fell from the clouds, could be otherwise than pure. But modern research, which has dispelled so many delusions and overturned so many idols, has demonstrated that our oldest and most respected source of water-supply has been a very Borgia of destruction, passing the poisoned cup to thousands and millions of unsuspecting lips.

Let us consider the manner in which foreign matter finds its way into wells. A well is too frequently a sort of drain for the ground in its vicinity, or more correctly, it is a receptacle into which flows the surplus water from a region varying in extent with the depth of the well and the nature of the adjacent soil.

If a quantity of perfectly wet earth be placed in a basket, a portion of the water which it contains (surplus water) will obey the law of gravity and flow away ; capillary attraction will cause the retention of the remainder. The facility with which this surplus water will flow off through a subsoil drain (see Fig. 141.) is familiar to all. The open drain gives, at every point on its surface, an opportunity for the drops of water lying adjacent to obey the law of gravity and flow off, seeking a lower level ; the drops immediately behind these follow closely, on account of the tendency of the first to form a vacuum, and so on indefinitely. Thus, a line of drops varying in length, is set in motion toward the drain, and in a few hours the soil in its vicinity is freed of its surplus water. Looking upon a well as a kind of perpendicular drain (and, under

circumstances which frequently exist, it acts as such for the soil in its vicinity), we readily perceive how it may become the receptacle for surplus water, especially when copious rains follow a period of drought; for then, the water being low in the well, and the upper stratum of the earth being saturated by a rain-fall, which, though abundant, is not sufficient to affect the remote sources of supply, the surplus water from a great distance passes without obstruction into the well, carrying with it whatever impurities it may have acquired in its passage.

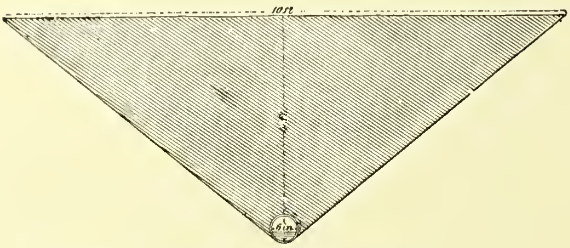


FIGURE 141.—Showing the area of drainage of a single pipe.

If the soil in the vicinity of a well could be kept perfectly free from foreign matter—if it could be kept clean, little harm would come from this surface water, though it must be remembered that the surface soil is the home of countless insects and small animals, and that it is the universal burying-place. This, however, is of small account compared with the danger to wells which arises from their near proximity to dwelling-houses and the deposits of waste matter which so universally accompany them. By means of these deposits the soil in the vicinity of wells frequently becomes loaded with filth.

The cesspool, the privy vault, the pig-pen, the barn-yard, the place selected for the deposit of laundry and sink water, are frequently grouped about the well and become centres of deposit, in which filth accumulates from year to year, causing the saturation of the soil in constantly increasing areas, so that the neighboring well, which at first may have furnished water which was perfectly pure, in time begins to receive the soakage of these accumulations. Sometimes this soakage into wells does not take place for a long time, and is then intermittent, depending upon rain-fall and other causes. Sometimes an accident, like the breaking or obstruction of a drain, will cause a well to be flooded with sewage; at other times, owing to the peculiar constitution of the soil and the conformation of the rock, sewage will find its way directly into a well, even though situated at a considerable distance. A case in point occurred under my own observation. The water in a certain well (see opposite page) having acquired an unpleasant taste and odor, the owner, supposing that the trouble arose from surface water, had his well taken up down to the rock, and from this point had the wall laid

in cement and a coating of hydraulic cement applied to its outer surface. Around this the earth was thoroughly packed. No benefit resulting from this change, the well was again taken up, and (the season being favorable) it was sunk to as great a distance

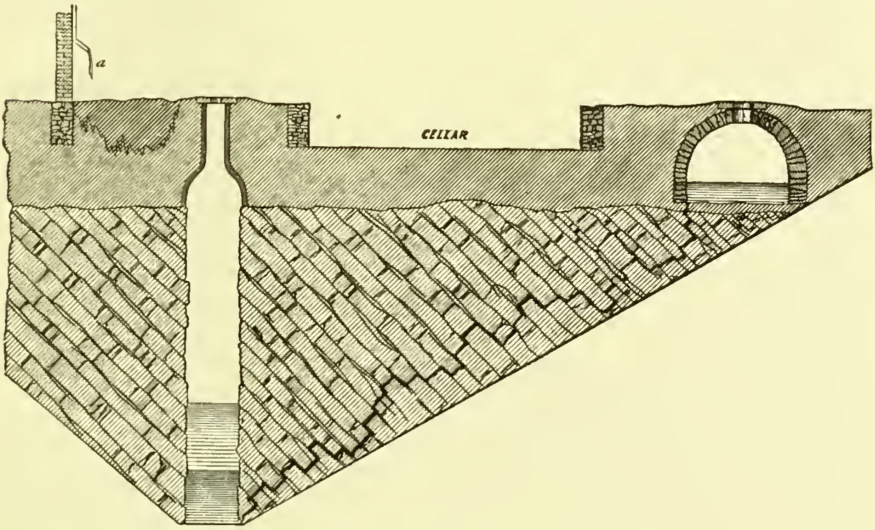


FIGURE. 142—A well contaminated by a cesspool.

as possible into the rock, making its total depth about thirty feet. The well was then walled up in the same manner as before. Water was carried from the bottom of this well into the house through a pipe, and was drawn from the surface with buckets. It was soon noticed that water which was drawn with the pump was bad, while that drawn with the buckets was apparently good. The cesspool was on the opposite side of the house, about fifty feet northeast from the well, and was excavated nearly to the rock (which is a red sandstone with a dip of about 45° to the northeast). At first it seemed impossible that fluids could find their way from this cesspool to the well, but the removal of the former to a distant part of the ground was followed by the disappearance of all the bad odor and taste from the water, forcing us to the conclusion that the contents of the cesspool *had* found their way along the fracture-lines of the red sandstone for a distance of sixty or seventy feet, in sufficient quantities to render extremely unpleasant the water of an abundant and constantly changing well.

The following is an example illustrating the contamination of wells which have done good service for many years. The pipe which conveyed the overflow from the laundry and water-closet

of a large boarding-house to a cesspool situated at a long distance from the house and well, became obstructed at a point about sixty feet from the well, and the ground in the vicinity of the obstruction became saturated with filth. In July of that year there was an unusual amount of rain. On July 6th, there was a thunder-storm; on the 7th, the hardest rain of the season up to that time; on the 16th, hard rain; 18th, showers; 23d, hard rain; 26th, showers all day; 28th, hard rain. During the month of August ten inmates of this house were down with fever—if not typhoid, something closely resembling it—and were severely ill, the majority of them, for five or six weeks. Early in August the water from the well was found to have a disagreeable taste, and efforts were made to have its use discontinued. The advice of the attending physician to have the handle of the pump removed was not followed, however, and it is altogether probable that the water was used to some extent after it was suspected of being impure, especially as no other cause could be discovered to account for the attack of fever, and as the well was situated in the front yard and supplied with a drinking-cup. This water was found to contain twenty-four grains to the gallon of solid organic matter.

In this case it appears certain that the frequent rains of July had washed from the saturated ground above-named, a large quantity of filth into the well, and that the fever was a result.

An open well, built in the usual manner with a stone wall backed by two feet or more of loose stones (see Figure 143) is liable to contamination in another way, viz.: from the decaying bodies of reptiles which have fallen into it and there died. Toads, especially, seem attracted during the hot, dry days of summer, to cool, moist, subterranean places, and sometimes great numbers of them burrow among the loose stones of which wells are constructed, and not infrequently fall into the water and perish.

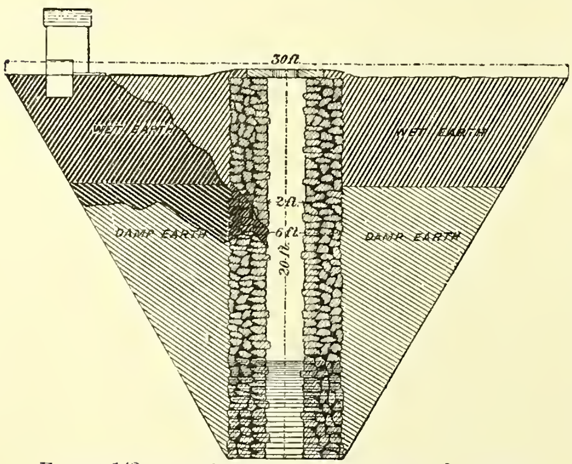


FIGURE 143.—A well constructed in the usual manner.

An experienced well-digger, who has cleaned hundreds of

wells, has been consulted, and says that he usually finds in wells from eight to sixteen inches of offensive mud, in which are imbedded the remains of many small animals, such as toads, frogs, rats, cats, dogs, etc., of which nearly a peck in various stages of decay he has sometimes removed.

Although there may be a considerable accumulation of these remains at the bottom of a well, when the water is abundant it may not be appreciable by the senses ; but when the water gets low, the matter then becomes more serious. So gradually, however, do the unpleasant odor and taste develop in such cases, that disease in the family is frequently the first announcement of impurity in the water.

We now come to the important practical question : How may a well be constructed so as to avoid or reduce to a minimum the chances of the introduction into it of matter detrimental to health ?

First, of course, the well must be so constructed that it cannot act as a drain for the neighboring soil. This can be done by making the wall above low-water mark of some material impervious to water, or by omitting this part of the wall altogether. The first can be accomplished by having the wall, from a point two or three feet from the bottom, made of brick with a coating of hydraulic cement (see adjoining figure) on its exterior, or of hydraulic well-tubing with the joinings well protected with cement ; in either case the earth should be thoroughly packed around the wall, and a slight embankment should be made around the orifice to prevent the inflow of surface or storm water.

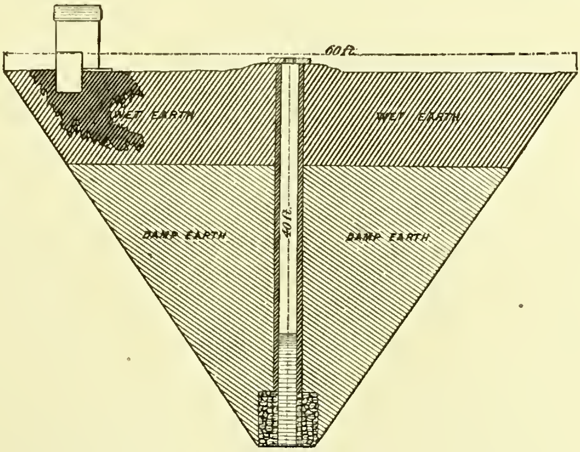


FIGURE 144.—Well with an impervious wall.

In such a well the draining surface is so reduced, and placed at such a distance below the surface of the ground, that in the great majority of instances the introduction of foreign matter becomes impossible, except in so far as there is a chance that substances will fall into the well from above. To prevent this the

well should be kept covered when not in use. In most cases, however, it is better to omit the upper part of the wall altogether (as here shown). After the excavation is completed, the wall can be built in the usual manner for a distance of two or three feet, more or less, as circumstances may demand; the service-pipe can then be placed in position, and the well arched over. The remainder of the excavation can then be filled with earth, well packed as it is thrown in, and the pipe carried to any convenient point. It will be necessary to place above the arch several layers of stone successively smaller, to prevent the falling of earth into the space below.

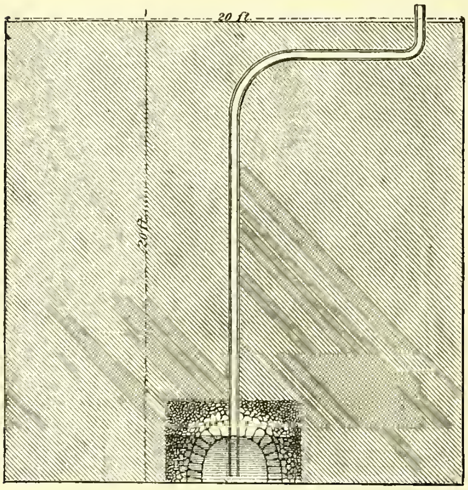


FIGURE 145.—A well arched over two feet from the bottom.

The workmen will probably suggest a layer of turf or straw to accomplish this object, but the presence of either of these substances will cause the water to be unpleasant for a considerable time, and will prove the cause of much annoyance.

There is a prevalent notion that a well should be ventilated for the purpose of allowing noxious gases to escape, and that water is better for being exposed to the air. It hardly need be stated that the only noxious gases in a well (*i. e.*, gases which render the water unwholesome) are the products of the decomposition of organic matter which has found its way into the well in ways which have been described above, and that water as it flows in its subterranean passages is quite as well aërated as it can be in any other way.

In the case of a well more than thirty feet deep, it will be necessary, of course, to have the lifting apparatus placed at a point within thirty feet from the bottom, as water cannot be drawn by suction from a much greater depth than this.

[Within a few years past there has been invented a substitute for wells made by digging, consisting of an iron tube, the lower end of which is provided with a sharp and solid point, and with perforations in the tube for a distance of a foot or more from the end. The tube being driven into the ground in sections, which are attached by means of screw-thimbles, a pump is attached to its

upper end when water has been reached. The sand or earth at the lower end of the tube is washed away by the flow of water, until a cavity is soon formed in which a considerable supply of water accumulates. In a soil which is pretty free from large stones, these "driven wells," as they are called, can be established with comparatively little expense or labor, and they are of course entirely free from the objections which have been mentioned as connected with open wells.]

Cisterns.

Rain-water, when collected in cisterns, is liable to contamination from the dust which collects on the roofs and in the gutters of houses. This dust, coming as it does from the street, is composed largely of the excreta of horses and other animals, and frequently, especially during a long period of drought, collects in such large quantities that the water containing it is abominably offensive and entirely unfit for use. To prevent this admixture it is necessary to have a shut-off in the leaders communicating with the cistern,

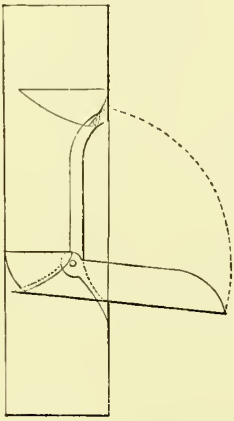


FIGURE 146.—Shut-off.

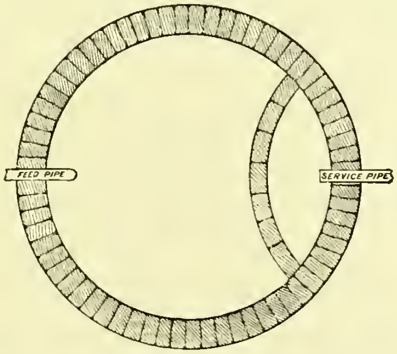


FIGURE 147.—Transverse section of cistern, with brick filter.

so constructed that the water can, at pleasure, be prevented from flowing into the cistern, and allowed for a sufficient length of time to wash thoroughly the roof and gutters, to discharge itself upon the ground, or to flow away through some channel prepared for it. A convenient shut-off, which can be made by any tinsmith, is represented by Fig. 146.

In addition to this, every cistern should be provided with a filter. A brick partition, made in a circular form, as represented in Fig. 147, makes a very good filter, as experience has shown. The par-

tition should be carefully built of bricks laid up in cement in such a way that there are no apertures between them, and of course should not be covered with cement. A better filter, however, can be made of charcoal, sand, and gravel. The cistern should, as before, be divided by a circular partition; only in this instance the convexity should be towards the smaller compartment which contains the filter, and that portion of the partition which is above the filter should be covered on its convex surface with cement. The first layer of bricks should be laid with spaces between them, as represented in the adjoining figure. The filter may be made in this way:

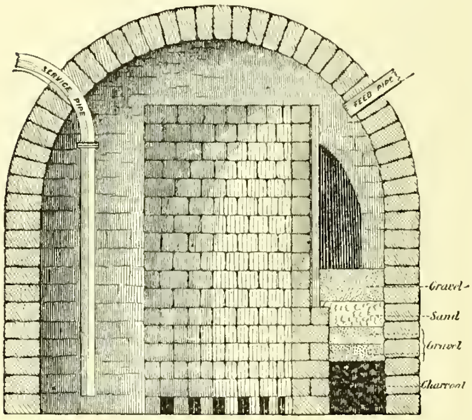


FIGURE 148.—Vertical section of a cistern having a filter of charcoal and gravel.

Place in the bottom of the smaller compartment a foot or eighteen inches of charcoal, broken to about the size of what is called nut-coal. Upon this place a layer of very coarse gravel about six inches deep, then a six-inch layer of ordinary gravel, then six inches of sand, then about a foot of coarse gravel. Water, in passing through a filter made in this way, will be so perfectly freed of impurities that it is suitable for any domestic use. It should be remembered, however, that any filter will, in the course of time, become clogged with foreign matter, rendering necessary its removal or cleansing. The sand and gravel can be put in a condition for doing duty a second time by washing, and the charcoal, by washing and heating in an oven. With all the care possible to prevent the introduction of foreign matter, it will be necessary to have a cistern thoroughly cleansed at least once a year.

Cistern-water frequently becomes saturated with sewer-gas from the cesspool or sewer into which the overflow-pipe of the cistern is made to terminate. Water has a great capacity for gases and is sometimes rendered extremely offensive by the absorption of sewer-gas. The remedy for this evil is to have the overflow-pipe terminate at some lower point on the surface of the ground, or in a drain which conveys water only.

No amount of care, however, in the construction of wells and cisterns lessens the importance which attaches to the proper dis-

position of refuse matter, for if it be allowed to accumulate in the soil, it will in time find its way into the deepest wells and into the most carefully made cisterns. In some of the older communities —London, for example—the ground is so saturated with filth, that the wells contain nothing but what may be called liquid sewage. The emanations from filth-sodden soil poison the air, as the soakage of it poisons our wells.

Water from Streams, Ponds, and Marshes.

[Water for drinking or cooking purposes ought never to be taken from marshy ground, or small streams draining marsh-lands, because of its liability to contain the germs which produce malarial fevers. Water from ponds and from lakes near the shore is likewise unwholesome, on account of its contamination with decaying organic matters.

It is without doubt that at different times varieties of animal life are to be found in the water of streams and some springs. But there is rarely or never so many as one would be led to believe from the marvellous exhibitions of "the living animals in a drop of water," made by travelling lecturers. The water most liable to be infested with these minute creatures is that of shallow ponds and ditches in which the putrefying organic matter furnishes them with the food upon which they subsist, and it is the presence of this putrefying matter, and not the animalcules, which may be considered as the cause of unhealthfulness. When, therefore, water from such sources is the only kind obtainable, it should first be thoroughly boiled and then filtered through gravel and charcoal.

Purification of Water.

It is not uncommon that the water of some streams is turbid from its admixture with clay and vegetable matter, and in this state is not desirable for drinking or other domestic purposes. If allowed to stand for a few hours in a tall vessel, the foreign matter will settle, and the upper part can be dipped or poured off. A quicker way to accomplish this is to dissolve a lump of alum, the size of a small butternut, in a quart of water, and then pour this slowly into a barrel full of the water to be clarified, stirring it meanwhile. The alum will curdle the vegetable matter in the water, and it will sink to the bottom, carrying all impurities with it. This amount of alum cannot be tasted when mixed with the quantity of water mentioned.

When water is stored in large quantities and excluded from light and air, as in the case of that which is used on ship-board, the vegetable matter which it contains, in nearly every instance, undergoes, after a few days, a process of putrefaction, and imparts to the water a very unpleasant taste and smell. After a time, however, when the oxidation of the decaying matter is completed, the water becomes again clear, and is then sweet and wholesome. Water which is undergoing this clearing process may be helped by the use of a small quantity of alum, as described above, and by subsequent boiling. Its "flatness" may then be corrected by pouring it for a few minutes, and at a considerable height, from one vessel into another, whereby it is made to absorb air and become sparkling.

It is customary, among many persons, when travelling, to avoid entirely the use of water as a beverage, for fear that it may cause disturbance of digestion and fever, and although the danger is doubtless much magnified, there is very likely some ground for the fear. The cause of trouble has never, that I am aware, been determined with certainty, but there is little doubt that it may be the organic matter present in the water. Causes of this sort, while they produce a state of chronic ill-health in those who are constantly exposed to their influence, may produce acute attacks in the case of new-comers.

The usual precaution is to add enough brandy, or other alcoholic liquor to the water, to destroy the vitality of any germs that may be present or coagulate the organic matter in solution. The quantity required to do this need not exceed one or two tablespoonfuls of liquor to a pint of the water, thoroughly stirred, and there is no occasion for making this measure an excuse for the substitution of alcoholic drinks for water as a beverage.

In filtering water, it is intended not only to remove all sediment, but also, so far as possible, to purify it of substances in solution. To accomplish the former, a bed of gravel is usually employed as a strainer; the second is accomplished, to some extent, by charcoal in small lumps.

When water is not supplied in pipes and under pressure, a filter can best be made of a clean barrel, which should stand on end and have near the bottom a faucet. A few inches above the bottom a false bottom, bored full of half-inch auger holes, should be supported on wooden blocks, and should itself be covered with a piece of coarse flannel. On the flannel should be put a layer, an inch or two thick, of clean, small-sized gravel, and on this a similar layer of pounded charcoal; then another layer of gravel, and on this more charcoal, and so on, until the layers come within a foot of

the top of the barrel, which should have no head. The top layer should be of gravel, and it is well to cover it with a second piece of coarse flannel, on which a few large gravel-stones are laid to prevent its displacement when a bucketful of water is poured in.

When water is supplied under pressure, a filter like the one here shown, and invented by Dr. Alex. Hadden, of New York, can be made with little expense by any capable tinsmith, and will filter a large amount of water without requiring to be often refilled.

Clean gravel is to be introduced into the lower portion (which holds about a gallon) through an opening in the top, which is afterwards closed with a screw-cap such as is used for kerosene oil-cans. The supply-pipe near the bottom is kept clear of gravel by means of a perforated grating. Attached to the top of the large can is a smaller one, holding about a quart and communicating with the former by means of a grated opening. The upper can is to be filled with pounded charcoal, to the level of a ring attached one-third of the way from the top, and on this ring rests a piece of perforated tin-plate which keeps the charcoal in place. The top of the small can is closed with a cover having a bayonet-catch, and provided on its under side with three strips of tin which hold the perforated diaphragm in place against the upward current of water. On the side of the small can, near its top, is a small pipe for discharging the filtered water. The supply-pipe at the bottom is to be connected by rubber-tubing with the stop-cock of a water-pipe.

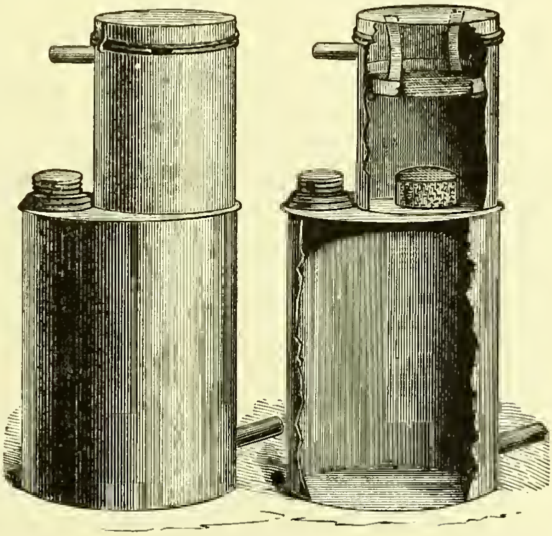


FIGURE 149.—Water-filter for use with water under pressure.

It is the charcoal of a filter which requires to be most frequently changed, and this arrangement permits this without disturbing the gravel or involving the trouble of arranging them in layers.

Water-Pipes.

The character of the pipes through which water is supplied for domestic purposes will influence its healthfulness in no small degree. At the present day, the pipes in most common use are lead, lead lined with tin, and iron coated with zinc, or "galvanized iron," so called. Besides these, there is a glass-lined iron pipe, which has been introduced to a limited extent, but the fragile and expensive character of the lining have prevented its becoming at all popular.

Of all the varieties, lead is in most common use, and, so far as healthfulness is concerned, it is unquestionably the worst, since under the action of the oxygen derived from the air (which running water especially contains in considerable quantity), and through the chemical decomposition of the water itself, it becomes rapidly lined with a dark film of the oxide of lead. This is not very soluble in *hard* water—that is, water containing sulphate or carbonate of lime—but in *soft* water, and especially in water containing nitrates or nitrites, this film of oxide is soluble quite readily, and most serious illness is almost certain to follow the use of such water as a beverage, or in the preparation of food. (See Chapter on Poisons.)

Next to plain lead pipe that which is lined with tin has been largely used of late, and when proper care is taken, in making joints, to have no solder exposed to the action of the water, this variety of pipe is practically one of the best.

There has been some discussion about the healthfulness of "galvanized iron" pipe as a conveyer, and tanks of the same material for the storage of drinking-water. A series of experiments have, however, shown* that the employment of this sort of pipe is practically harmless. It is found that in time the zinc may often become separated from the iron, when the iron rust which forms and is washed away is apt to impart a color and unpleasant taste to the water, but its effects on the health are in nowise prejudicial, as are those following the use of lead pipe.]

Examination of Water.

It requires a professional chemist to make a thorough analysis of water; and where there is any doubt remaining after the application of the simple methods which are given here, a specimen of

* Report of the State Board of Health of Massachusetts for 1874, p. 489.

the suspected water should be sent to his laboratory for more careful examination. The bottle in which the water is sent should be thoroughly washed with soap and water, then with strong sulphuric acid, and finally with the water which is to be analyzed. A quart of water is generally sufficient (although more is desirable if it can be had), and it should be collected in a glass-stoppered bottle. If the water is to be sent any distance, the stopper should be secured with a piece of strong muslin securely fastened around the neck of the bottle. In collecting the specimen care should be taken to obtain one which fairly represents the suspected water.

Dr. Wilson recommends the following methods of examination :

1.—*Physical Examination.*

A portion of the sample collected should be poured, after shaking the bottle, into a good-sized clear glass flask. If the glass is then held in front of a dark-colored surface, with a good light falling on the side or from above, any suspended impurities will become visible, but care should be taken to discriminate between them and air-bubbles.

Color and *turbidity* are best ascertained by pouring the water into a tall vessel of colorless glass, two feet high and one inch in diameter, and placing it upon a porcelain slab or piece of white paper. Another glass of the same dimensions, filled with distilled water, should be placed by its side for comparison. Both samples are then looked through from above, and the difference between them noted. If organic matter is present, the water has usually a tinge of yellow, green, or blue, but mineral substances may give similar indications.

Clay, *peat* and *other* harmless contaminations impart a brownish tint. If the turbidity is considerable, or if the water is very dark in color, it may be pronounced unfit for use, although filtration may render it perfectly wholesome.

To observe the *smell* of the water, a portion of it should be poured into a wide-mouthed flask, making it about one-third full, and then shaking it well. If the smell is unpleasant, the water is unfit to drink. Should no smell be detected, the flask should be heated, and the water again shaken, and if there is still no smell, a little caustic potash should be added to the warm water. Any unpleasant odor which may now be given off indicates with tolerable certainty that the water contains organic impurities in considerable quantity. The occurrence of a *precipitate* on the addition of caustic potash will, at the same time, indicate hardness.

2.—*Chemical Examination.*

Total Solids.—The amount of total solids is ascertained by evaporating a known portion of the water along with the sediment to dryness, and weighing. For this it is sometimes necessary to have at least three or four quarts of the water to be analyzed. If the residue in the evaporating dish blackens when it is incinerated over a flame, the presence of organic impurities is indicated; and should a bad smell be given off at the same time, it may be inferred that some of these impurities are of animal origin.

Another test for these impurities is to suspend a piece of filtering-paper, which has been steeped in a solution of potassium iodide and starch, and afterwards dried, over the dish during incineration; if this becomes blue, it shows that nitrous acid fumes are being given off, which almost always arise from animal, and not from vegetable matter.

According to Dr. Parkes, the total solids in good water should not exceed eight grains per gallon, unless it be a chalk-water, in which case they should not exceed fourteen grains of calcium carbonate. Usable waters may, however, contain as much as thirty grains. The organic matter should scarcely blacken on incineration, or, if the blackening is considerable, it should be ascertained to be chiefly due to the presence of vegetable matter.

Lime.—Pour a little of the water into a test-glass, and add a solution of ammonium oxalate. Six grains of lime per gallon will yield a slight turbidity; sixteen grains, a distinct precipitate; and thirty grains, a large precipitate soluble in nitric acid.

Magnesia.—In a good water there should only be a slight haziness, or none at all, on the addition of ammonia. An excess of lime or magnesia is evidence of hardness.

Lead and *iron.*—Boil between three and four ounces of the water acidulated with a few drops of sulphuric acid, and afterwards add sulphuretted hydrogen water. If a brown or blackish coloration is produced, the presence of lead may be inferred. If no color can be detected, add a little potash or ammonia, and if this produces a blackish precipitate, iron is almost certain to be present.

Chlorides.—Acidulate a little of the water in a test-glass with a few drops of dilute nitric acid, and add a solution of silver nitrate. Four grains per gallon of sodium chloride give a turbidity; ten grains a slight precipitate; and twenty grains a considerable precipitate, soluble in ammonia. A good water should yield only a slight haziness. If there is a distinct precipitate, it shows that the

water is derived from sand or some formation rich in salt; that it is brackish if on the sea-coast, or that it has been contaminated with sewage. In the first two cases there will be a large amount of mineral solids, and the last may be decided by confirmatory tests.

Sulphates.—Acidulate with a few drops of hydrochloric acid, and add a solution of barium nitrate. A good water should not give more than a slight haziness.

3.—*Organic Matter.* (*Potassium Permanganate Test.*)

The test solution should consist of two grains of the permanganate of potassium to about ten and a half ounces of distilled water. About half a pint of the water to be examined is acidulated with a few drops of hydrochloric acid, and the solution slowly added while the water is stirred with a glass rod until a faint pink tinge is perceptible. This can best be observed by using a colorless glass vessel placed on a sheet of white paper, and by looking down through the water on the paper. As every ten minims of the solution yield $\frac{1}{1000}$ of a grain of oxygen, the amount of oxidizable matter in the water can thus be approximately estimated. The amount of solution required to produce the perceptible tinge should be noted, and at the end of every fifteen minutes a few drops more of the solution are to be carefully added, until the color remains permanent for half an hour.

The value of this test depends upon the fact that putrid organic matter rapidly decolorizes the solution, while that which is less decomposable, and therefore not so injurious, decolorizes it more slowly. But as sulphuretted hydrogen (recognizable by its smell), nitrites, and iron, also effect a rapid decoloration, the chemical tests for these should be applied, to ascertain whether or not it is to be attributed to their presence. With these limitations, therefore, the permanganate test gives valuable information, and when used in conjunction with other tests, a reliable opinion as regards the wholesomeness or unwholesomeness of a water may be confidently given. Rapid decoloration is strongly indicative of direct sewage contamination.

J. W. PINKHAM, M.D.

Hygiene—Clothing.

BY

JOHN V. SHOEMAKER, A.M., M.D.,

OF PHILADELPHIA, PA.,

LECTURER ON DERMATOLOGY AT THE PHILADELPHIA SCHOOL OF ANATOMY; PHYSICIAN TO THE PENNSYLVANIA FREE DISPENSARY FOR SKIN DISEASES, ETC., ETC.

CLOTHING.

General Nature and Purposes of Clothing.

CLOTHING fulfils the several purposes of decent concealment of the person, of protection against outside influences, and of retention of the body-warmth. Not infrequently we seek a fourth object: that of adornment; and tendencies of this latter kind are seen both in the lower ranks of savage life, and in the most highly enlightened races. Indeed, it is unfortunately too true, that among highly civilized nations, social customs often create forms of dress which not only fail to fulfil the proper functions of clothing, but also become the active causes of serious disease. A study of clothing must, therefore, include some remarks on what it should *not* be, as well as on what it *should* be.

The human body, like that of most animals, is possessed of a power to maintain its temperature at a certain point, without reference to the temperature of surrounding objects. Under some conditions we can be comfortable without clothing; and the savage races that inhabit the warmest parts of the globe go entirely or nearly naked. The limits within which we can keep up the body-temperature without covering, are very narrow, and when they are passed we quickly suffer from the exposure.

Many animals are provided with an extensive hair-growth which is rudely adapted to the change of seasons; the heavy winter coat being shed on the approach of warm weather and renewed on the return of winter; in our own bodies this growth never amounts to a serviceable covering, except upon the head.

The special function fulfilled by clothing is to prevent too rapid loss of heat, either from the actual contact of wind or of cold air, or by the cooling effect produced by the evaporation of the perspiration. It is scarcely necessary to say that the different fabrics used have no heat or heating power in themselves; they are simply *non-conductors* of heat. Certain goods give to the touch a

sensation of coolness, but this is a deceptive sensation, the nature of which will be presently explained. Clothing acts simply as a retarder. The constant tendency of our bodies, when their temperature is higher than that of the surrounding air, is to give out heat rapidly, in order to equalize the conditions. The greater the difference of temperature, the more rapid will be this loss of heat, and the more necessary becomes the retarding influences. Scientific investigation shows us that the rate at which heat is transmitted from point to point through any substance, varies very much with the nature of that substance. The more compact and uniform the structure, the more rapid the transmission, or, as it is called, conduction. On the other hand, bodies that are spongy, and the structure of which is not uniform, and especially bodies that contain numerous pores filled with air, have a low conducting power—that is, it takes a long time for heat to pass through the substance. Materials of this latter kind are most commonly employed in clothing. They are derived from both the animal and vegetable kingdom ; wool and silk being examples of the former, cotton and linen of the latter. The minute microscopic study of these different articles shows a certain characteristic structure in each, but they are substantially porous materials containing air. The conducting power of linen is superior to that of the other materials mentioned, and by carrying away rapidly the warmth of any part of the body which it touches, linen gives a sensation of coolness, which makes its temperature seem lower than it really is.

The property of low-conducting power is not the only quality which articles must have in order to be fit for use as wearing apparel. Glass is a substance that transmits heat very slowly, but experiment has shown that it is quite inefficient as a means of preventing loss of heat. This result is explained by the fact that glass is a good *radiator*, that is, it parts with heat very rapidly from its surface. It is evident that our garments should be bad radiators, and by experiment we find that the various articles we use for our daily wear are in pretty close agreement in this respect ; they retain for some time the portion of heat which they have received, whether from the body or elsewhere.

Distinctive Properties of Different Materials in Common Use.

Linen, as already mentioned, is a good conductor, and its cooling action often renders it uncomfortable and unsafe. It is, perhaps, of all the common fabrics, least liable to chafe the skin ; its use in handkerchiefs is one of the results of this property.

Cotton is a vegetable fibre, and while having, to a great extent,

the softness and pliability of linen, is rougher and less grateful to the skin. It, however, possesses a power of absorbing moisture far greater than that of linen, for which reason it is the favorite material for underwear in tropical climates where perspiration is abundant.

Wool is of the nature of fur, and is an excellent non-conductor, being superior to both cotton and silk in this respect. Unfortunately, it is highly irritative to many skins, and friction of it excites electrical disturbances which give rise to unpleasant sensations, thus preventing many persons from taking advantage of its qualities. A judicious combination of linen and woollen garments will, however, enable one to enjoy the benefits of both these materials.

Silk has many points of advantage as an article of dress. Its expensiveness will be sufficient to limit its use, and it is not altogether without a drawback, for it becomes highly electrical on friction, and it may thus become a source of irritation, or may even occasion inflammation.

The color of an article of dress has no appreciable influence on its protecting power, except, perhaps, in cases in which the process of dyeing and finishing has modified the thickness or compactness of the tissue: but such cases are infrequent and of no special interest. When, however, we consider dress as a protection against *outside* temperature, as when it is worn under a summer's sun, some important effects are produced by differences of color.

Experiment has shown that the rapidity with which heat is absorbed by differently colored stuffs, may be put in this order: yellow, green, red, blue, black; the first absorbing the least heat, the last absorbing the most. This result is, in the main, confirmed by our ordinary experience. Dark clothes are much more uncomfortable in the sun than light ones. Some curious departures from the proper rule are to be noticed. The British soldier, in his coat of red, has suffered not only from presenting a better mark to the enemy than would have been the case if his attire had been an humble gray, but he has suffered, also, as a mark for the sun, the fiery beams of which have made standing by his *colors* heroic work.

Special injury is sometimes done to the skin by colored underwear. Such effects must not be confounded with those cases in which exists a special susceptibility to irritation by certain fabrics. What is here referred to, is the local irritation by the chemical substance used in the dyestuff. Some of the beautiful dyes which modern chemical process has given to us, the coal-tar colors for instance, are apparently decidedly irritating. Fuchsine and coralline, two brilliant red dyes derived from some of the ingredients of

coal-tar, have been used for coloring stockings, gloves, etc., and have awakened inflammation of the skin, sometimes very severe in character.* Discontinuing the use of the colored article does not always stop the trouble, for the dye is frequently transferred to the skin, exhibiting, in outline, the design and pattern of the goods, and as these colors have a particularly strong power of adhering to animal matters, the irritation may continue until time has dislodged or destroyed the substance. Inflammations of the skin produced in this way sometimes extend beyond the point of application of the color; and relapses have occurred after apparently complete recovery. The blue dye used for caps and pantaloons, has frequently, in my experience, excited the worst forms of tetter; especially have I noticed this among sailors who wear blue overalls.

In this connection it will be appropriate to say a few words about colored flannels. Red flannel enjoys great popularity, as the most suitable material for general wear by persons afflicted with rheumatic tendencies. It is probable that this opinion is in part due to the idea that red is a warm color. With reference to the power of absorbing the sun's heat, this notion is in part true; but, as an agent for retaining heat and retarding conduction, the color is without value. It is stated that in consequence of some conditions occurring in the manufacture of flannels, red flannel of any grade or price is apt to be the heaviest or stoutest of its grade, and this would lead to its being preferred.† Experience shows that the red color may cause irritation of the skin; indeed, I have had occasion to notice a number of times, both in young and old persons, that it will excite nettle rash, and that the intolerable burning and itching will continue a long time after the wearing of the garment has been abandoned.‡ Red flannel also may induce "liver spots" in those who are predisposed to them.

[* The poisonous nature of these colors is not so much due to the coal-tar products as to the arsenic and other substances occasionally used in their manufacture, and which are sometimes imperfectly removed.

† The scarlet color used in dyeing flannel will act better upon wool than upon cotton; and when, for purposes of adulteration, cotton has been mixed with the wool, the cotton threads either show white, or they are but slightly tinted with color. Since it is the *wool* or animal fibre which is sought in purchasing flannels, and not *cotton*, the fact that the fabric has a uniform scarlet color, is one evidence that it has not suffered from admixture with a cheaper and less desirable material. This has often led to the recommendation of *red* flannel without an accompanying explanation of the reason, and in time there has grown a popular belief that there is something especially valuable in the color. This test is said to be less reliable since the use of aniline dyes.

‡ In these cases it is not improbable that the dye-stuff contained arsenic in some form.—Ed.]

As has already been mentioned, the non-conducting character of our clothing is largely due to the air contained in the pores of the materials. It follows from this that clothing, when it consists of several layers enclosing warm air between them, will be warmer than the same weight of material disposed in one compact mass. For this reason, the practice of wearing two distinct sets of clothing—the under- and over-wear—is to be recommended, as affording the most satisfactory use of the materials.*

The exhalations from the skin find their way into the pores of our clothing, and although these exhalations consist chiefly of water, a certain amount of easily decomposable organic matter is also present. The water, in time, evaporates, the organic matter remains in the fabric, and, by decomposing, renders the clothing foul and unwholesome. With ordinary linen and cotton stuffs we can remove this by washing, but with goods composed of silk, wool, or hair, this method is, for obvious reasons, objectionable. Articles of this kind must be cleansed by being aired, in which process the oxygen of the air combines with and actually burns up the organic matter. Especially should all articles which are in direct contact with the skin be subjected to frequent and thorough airing. Bed-clothing should be exposed for as long a time as possible, and the practice adopted by many persons of making up the beds compactly, early in the morning, is a very improper one, and is only a lighter phase of the iniquity of putting a guest to sleep in a spare room, where neither bed-clothing nor anything else may have been aired for a year or more.

The alternation of day with night should be taken advantage of during the *entire* year, to secure thorough airing of all the articles which are likely to have absorbed perspiration. Clothing worn during the day should be entirely removed on going to bed; the night attire should have the benefit of exposure to air during the day, and this end will not be attained by keeping the night-dress folded compactly under a pillow. When the weather is severe, this entire change may be disagreeable, but it is rarely injurious, and one who once gets accustomed to the pleasant sensation of well-aired clothing, will not easily adopt other practices. In exceptional cases, as where the health is feeble, the change of clothing at night may be made in a warm room; the articles having

[* An objection to the employment of cotton-flannel instead of woollen goods, as a material for under-garments, aside from the fact that it contains no animal fibre, and is therefore inferior to woollen-flannel as a non-conductor, is the fact that while it is unwashed, it encloses a considerable amount of air in its meshes, but the effect of washing upon it is to render it more compact, capable of retaining less air, and less serviceable, therefore, as a means of retaining body-heat.—ED.]

been brought in a few moments previously and warmed. It is equally important that during the night the day attire should have opportunity to air, and this is often prevented by slovenly habits of drawing off the clothing and throwing it in a heap on some table, chair, or perhaps on the floor. The different articles, especially the under-clothing, should be separated, and arranged in such a way as to give free access of air.

This review of the general principles involved in use of clothing will enable one to understand properly the special points in regard to season, occupation, etc.

Summer Clothing.

In the warmest summer weather the lightest clothing may feel burdensome, and we seek, by diminishing it to the smallest amount consistent with propriety, to lessen our inconveniences. Much of our discomfort arises from the accumulation of perspiration, the free evaporation of which is prevented by the clothes. We should select, therefore, such garments as have decided power of absorbing moisture. Wool stands very high in this respect, and it is a matter of common knowledge that flannel garments are among the most comfortable articles for summer wear. They act by absorbing the vapor and perspiration given off from the surface of the body, and by retaining it so firmly as not to feel wet or clammy. It is an important point to bear in mind, and one somewhat difficult to comprehend, that dampness does not depend upon the amount of water actually present in the air, but upon the degree of attraction with which the water is held. A fall of temperature will convert a dry air into a damp one, without the addition of any water, simply because the capacity of the air for moisture is diminished.* On the same principle we can account for the great difference between wool and linen as articles for summer wear. Linen has a low capacity for absorbing moisture ; it quickly becomes saturated, and under slight change of conditions parts with its moisture rapidly. For this reason, when worn in contact with a perspiring skin, it soon becomes wet and clammy, and if the temperature of the outside air rises, or the surface be exposed to a current of air, the rapid evaporation produces a dangerous cooling of the body. Were it not for these objections, the smooth and pleasant surface of linen would make it a favorite for summer use.

Fabrics which have no power of absorbing moisture are quite uncomfortable, and if worn regularly would prove injurious. They

* See, also, Chapter on Air.

allow the perspiration to accumulate, and this fact is the objection to the otherwise serviceable water-proof materials.

In situations directly exposed to the sun's rays, the use of light-colored clothing is to be preferred.

Winter Clothing.

In the rigorous season of the year we are obliged to increase considerably the quantity of clothing, and this entails several sources of injury to the comfort and health. We bear, unwillingly, the burden of overcoats, wraps, furs, etc., postpone the wearing of them until the last moment, and hasten, at the first approach of warm weather, to lay them aside. The frequency, in the spring and autumn, of colds, with their manifestations of sore throats, catarrhs, etc., for which troubles we are too ready to shift the blame from ourselves to the climate, is in part due to indiscretion in dress. Our constant endeavor should be to adapt the warmth of the clothing to the state of the weather, with reference to the individual.

It must not be forgotten that clothing interferes, to a certain extent, with the normal function of the skin as an excretory organ; hence the impropriety of retaining, when in warm rooms, the extra clothing which is merely intended for protection against the severe out-door temperature. Many persons, especially women, will sit in warm rooms heavily encumbered, rather than take the trouble involved in a removal of some of the outer garments. The individual being thus bundled up, the perspiration accumulates, and on going out into the air a great quantity of moisture is evaporated (especially if there is wind), and unwholesome chilling of the skin results. Equally objectionable is the practice of keeping in cold rooms, those garments intended for out-door wear. Such articles should be kept in warm and ventilated apartments, and not, as is usually the case, in cold halls and corridors. Part of the beneficial effect of such clothing is due to the non-conducting stratum of air which they enclose; and that this should be warm, and not cold air, is very easily seen, and is proved by the disagreeable feeling produced when such garments are brought in from the cold and drawn over the warm body.

Tight Clothing.

Considerations of elegance, comfort, and efficiency, require that the clothing should fit nicely to the body. Garments that hang loosely, are not merely inelegant, but, by allowing too free circula-

tion of air, cause rapid cooling. That a well-fitting dress is warmer than a badly-fitting one in no way justifies, however, the extreme of close-dressing, so common among us. The proper idea of a dress is one that adapts itself easily to the figure, and when, by "band, and gusset and seam," or any of the other inventions of the *modiste*, we strain and distort either trunk or limb, the dress becomes a cause of disease, and the daily experience of medical men only too well confirms this statement. The clothing of women suffers from these perversions much more than that of men. It will be well to consider more in detail the dress of both sexes.

Male Attire.—The modern fashions for men are, in the main, those of comfortable garments. Extravagances in the form of certain articles appear now and then, but they are not very serious. Low-cut vests, by exposing too much of the delicate parts of the chest, may give rise to lung affections, and low-necked shirts and open collars may be unsuitable to those who are predisposed to throat troubles and catarrh, but coats and overcoats are now made to button up so closely that, in the colder weather, these deficiencies are not felt. In the matter of clothing for the head and feet, however, men are often most absurdly and injuriously dressed. A full discussion of these topics will be given elsewhere.

Female Attire.—The outline of the female form has been justly regarded by ancient and modern artists as the highest type of beauty. It is, therefore, very remarkable, that among civilized nations, the prevailing fashions in women's dress should be such as to destroy both beauty of figure and healthfulness of body. The drawing in of the waist is of course the greatest of the sins. The bony frame-work of the chest is naturally somewhat wider below than above. Tight lacing reverses this arrangement, displaces the internal structures, forcing the abdominal organs downward toward the hips, and compressing the lungs so as to interfere with breathing.* Of the diseases which result from such practices, it may be truly said their name is legion. Lung troubles, palpitation, dyspepsias, liver complaint, displacements and injury to the womb—all these are seen daily, resulting from this habit of forcing the chest-walls into an unnatural shape. This seems the

---

[* It may be remarked that females, after the age of puberty, breathe principally with the upper portions of the chest, while in males the lower portion of the chest is most employed in respiration. This circumstance is universal, and does not depend upon habits of dress, since it has been observed among savage tribes who wear little or no clothing. For this reason, women can endure, without *feeling* any oppression of breathing, garments which confine the lower ribs, and which would be absolutely intolerable to men.—ED.]

more deplorable, when we remember that no advantage, even in external appearance, is gained, for the small waist is in no sense beautiful.

The accompanying cuts will show the difference between the bony thorax or chest-wall in its natural condition, and the state of it when modified by tight lacing.

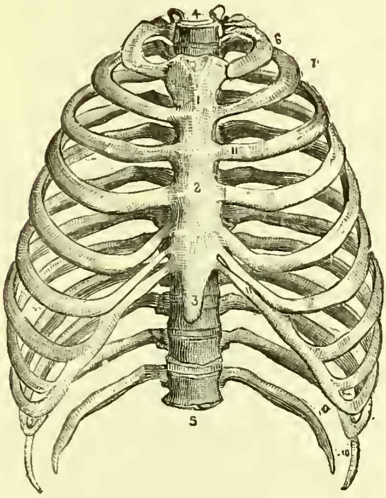


FIG. 150.

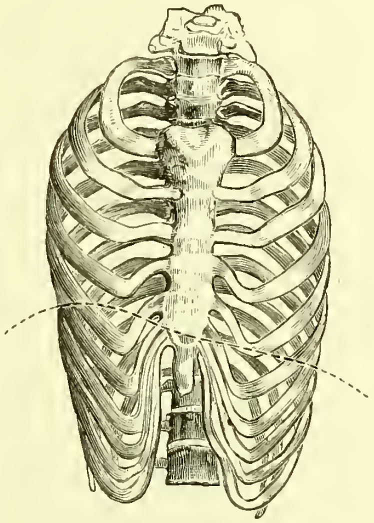


FIG. 151.

FIGURE 150.—Bones of the chest in their natural relations.
FIGURE 151.—Bones of the chest which have been distorted by tight lacing.

As regards the corset, which is the principal means by which tight lacing is accomplished, it cannot be said that in its customary form it is an injury. When its curves and contours are patterned after those of the chest, a well-fitting corset will often support and equalize the weight of the dress, and give roundness and elegance to a flabby figure, without interfering with any function or disturbing the internal organs. As usually made, however, it allows too little circulation of air. The cheaper forms are especially objectionable, since they have a simple hour-glass shape, and bind the body at one point only. The proper form would be a light and open framework, fitted to the body by measurement, as in the case of any other garment. Such a garment would act as a dress-supporter, which is its true function, and not as a chest-compressor, as is the case with the ordinary form.

Whatever may be said in favor of allowing the corset to adults, its use by children cannot be too strongly condemned. Their figures never require, either for beauty or comfort, any such arti-

ficial assistance. Their chests should be allowed to develop unfettered by any outside interference. If the use of the corset by children could be entirely prevented, the custom of tight lacing among adults would be very much diminished, for no woman could bear the extreme reduction of the waist unless the compression had been begun in early life.

Tightness of Neckwear.—The neck should not be tightly constricted in either sex. Besides producing irritation and discomfort (a result often increased by the enamel or finish used to give gloss to the collar), it interferes with escape of perspiration. The clothes may be compared to the jacket of a steam-pipe, and the warm air tends to rise and pass out at the neck, while fresh air is admitted below. Close-fitting collars prevent this change of air.

[It has also been proven that soldiers serving in warm climates are far more liable to congestions of the brain and sun-stroke when they are obliged to wear the high and rigid leather stock which at one time was an essential feature of their uniform.

Tight Girdles and Waist-Bands.—Laboring-men, sailors, soldiers, and others, sometimes suffer injury from constriction of the waist by tight belts and waist-bands. The most serious effect of this habit is the production of ruptures, or hernias, during efforts at straining or lifting. Moreover, constriction of the abdomen in men is in some degree equivalent to the wearing of tight corsets by women, since in the former the movements of breathing are performed largely by the lower part of the chest, the muscular diaphragm which separates the chest-cavity from the cavity of the abdomen, and by the abdominal muscles ; and anything which constricts the latter will not only favor rupture, as above stated, but will interfere with complete filling of the lungs, and thus, for persons especially affected with a disease of the heart or lungs, this practice may be very harmful.

Tight Garters.—The wearing of tight garters may lead to enlargement of the veins and lymphatics of the legs ; and by impeding the flow of blood upwards, may favor the conditions of cold-feet and chilblains in cold weather. The custom recently introduced of supporting the stockings by means of elastic straps buttoned on to the corset is, therefore, worthy of general adoption.—Ed.]

Coverings for the Head.

The head is the only part of the body so protected by nature as to need no artificial covering. The hair is similar in general structure to the wool and fur of the lower animals, and constitutes,

in healthy growth, an excellent non-conductor. It is, by unnecessarily covering our heads, that we bring about a variety of scalp affections, the ultimate result of which is to cause loss of hair. If the head received proper attention, many cases of general thinning and premature baldness might be prevented. The use of hats and bonnets should, as much as possible, be avoided; these, if worn too constantly, will cause retention of the secretions of the scalp, attended with itching, and the effort at scratching may excite disease.

The stiff hats so extensively worn by men, produce more or less injury. Premature baldness most frequently first attacks that part of the head where pressure is exerted by these hats. It is, indeed, a pity that custom has so rigidly decreed that men and women must not appear out of doors with heads uncovered. It would be far better for the hair if to be bare-headed were the rule, and to wear a hat the exception. Since we cannot change our social regulations in this respect, we should endeavor to render them as harmless as possible. The hat should not be worn except when absolutely necessary. Children especially, about whose appearance society is not very seriously concerned, should be allowed to go bare-headed as much as possible.*

Some slight improvement upon the construction of head-coverings has been attained in the last few years by the invention of ventilated hats. The ventilation, as is well known, consists, usually, of perforations in the top and sides of the hat. The effect is to cause free circulation of air, and prevent the accumulation of a hot and sweat-laden atmosphere about the hair. It is doubtful, however, if the method, so often followed, of simply putting a few holes in the top of the hat will have much effect. For summer-wear good straw hats are made, with large open spaces around the crown, securing complete access of air. In many cases, such as where persons are working in the sun, a broad-brimmed straw hat may be worn as a shade, but wherever possible we should pro-

* [An exception to this occurs in the necessity for protecting the eyes from too bright a light. For young children this is quite essential, and the necessity for doing so will compel the use of some variety of head-covering, on the part of adults, at times when it would not otherwise be necessary. A shield of this sort against the strong rays of the sun is also of service in preventing the skin of the face, neck, and ears from being made sore. Still another purpose which may be accomplished by a suitable head-dress, is protection from wind and rain for the back of the neck, which is, ordinarily, very sensitive to their effects. All these purposes are best served by a hat having a moderately broad brim and a soft crown, which exerts uniform pressure. The custom which leads females to carry a parasol, permits them to wear a less cumbersome head-dress in summer, although, by requiring the exclusive use of a hand for its support, they are thereby restricted in their movements.—Ed.]

tect ourselves from the sun's rays by some other means. When walking out of doors in sunny weather, it would be best to discard the hat and carry a sunshade.* The evil that may be done by colored caps has already been touched upon (p. 212). With regard to that fashionable abomination, the silk hat, no words, except of condemnation, can be bestowed upon it. Uncomfortable, inconvenient, and ungraceful, its continued popularity is one of those freaks of fashion which show us "with how little reason the world is governed."

The forms of hats that are least injurious are, for winter, soft hats of light weight, having an open structure, or pierced with numerous holes ; for summer, light straws also of open structure.

[The latter can be made still more serviceable in the direct rays of the hot sun by filling the upper part of its crown with fresh leaves.—Ed.]

The precautions that have been given in regard to keeping winter clothing in warm rooms, does not apply to the head coverings ; these may be kept in the cold, as the hair needs no warming. The habit of removing the hat when one comes indoors, should be cultivated, and the custom should not be limited to those cases in which it is required by courtesy.

As regards the head-covering of women, the fashions have been for several years favorable to proper form. The bonnet and hat have become quite small, and cover but little of the head. This beneficial condition, however, is in part counterbalanced by the weight of false curls, switches, puffs, etc., by the aid of which women dress the head. These, by interfering with evaporation of the secretions, prevent proper regulation of the temperature of the scalp, and likewise lead to the retention of a certain amount of excrementitious matter, both of which things are the most prolific source of rapid thinning and loss of hair in women.

* [In India, China, and neighboring countries, it is found that a straw hat alone is not sufficiently impervious to the direct rays of the sun, and it has, therefore, become the custom to surround the crown of it with loose folds of very thin white muslin. This, by holding in its meshes a large amount of air, serves as an excellent non-conduct r, and also, by its color, retards the absorption of heat. It would be a proper fashion to adopt elsewhere in midsummer. Another hat, likewise worn in the East, is made of the pith of some plant, or of cork-bark, and covered with muslin. The nature of the material protects the head from the solar rays, while the free circulation of air is secured by having the hat made larger than the head and supported by a snugly-fitting band, to which the hat has occasional connections. It would, at first sight, appear inconsistent that in such warm countries as Turkey and Persia, thick head-dresses of muslin, felt, or lamb's-skin should be so universally worn, but this is explained by the fact that the hair is either shaven or cut very closely, to facilitate cleanliness, and the felt, muslin, or lamb's-skin cap or turban is used as a needed protection against the sun's direct rays.—Ed.]

False hair has, likewise, sometimes been the means of introducing parasites, which give rise to obstinate affections of the scalp.

Wet Clothing.

When clothing becomes wet, its properties are materially changed. Its weight is much increased and, by the filling up of its pores with water, its non-conducting power is much diminished, and the heat of the body is conveyed away more rapidly. Besides this, the constant evaporation of the water abstracts heat from the garments and makes them cold. We have, therefore, two sources of being chilled : when our clothes are wet, and by contact with a cold material and the consequent rapid conduction of heat. It is merely necessary to remark here that wet clothes should be removed as soon as possible, and replaced by those which are not only dry, but warm.

[Wind- and Rain-Proof Clothing.

It becomes sometimes necessary to protect the body from the effects of wind and rain, and for either there is nothing quite so serviceable in every respect as garments of india-rubber. These, however, are liable to be made of bad material, or even when well made, unless carefully dried and properly put away, are liable to become spoiled. In warm weather, especially, the gum is apt to become adhesive, and the effort to separate its surfaces leads to its practical destruction. When torn or perforated, india-rubber garments are not easily repaired, and all these considerations make it desirable that something else may be found to take their place. Sailors make for themselves garments of muslin, and saturate them with linseed oil—oil-skins, so called—and though the reverse of elegant in appearance, they are extremely serviceable against both wind and rain. Italian and Tartar shepherds wear jackets made of black lamb's-skin, with the wool outside, and these are likewise impervious. In China and Japan, paper and cotton fabrics are made water-proof by giving them a coating of glue or albumen, to which a small amount of bichromate of potash dissolved in water has been added. The mixture must be made in the dark, or by lamplight, and the fabric is afterwards to be exposed to sunlight, when the glue becomes insoluble in water, although retaining its flexibility.

Cloths with long and overlying naps (as some of the Mackintosh variety), or the loose-textured water-proof materials, by entangling air in their meshes, prevent the entrance of water (unless

under pressure of strong wind), just as the air held by the hairs on the surface of a clover-leaf will keep it dry for hours, although immersed in water. In England a variety of loose-textured frieze, called *aqua-scutum*, is made by subjecting it to a preparation which renders its fibres impervious to water, while the air in its meshes serves to repel any moisture on its surface.

The use of wraps, made of the skins of animals, has been customary among civilized races since time immemorial, and there is probably no material at once so elegant and serviceable as a protection against the two elements here referred to.

Fire-proof Clothing.

In some occupations it is desirable that clothing should be worn which is not readily combustible. This is especially true in the case of ballet dancers and actresses, whose dresses of light materials have often burned so rapidly when brought in contact with the flaring lights of the stage, that loss of life or irreparable injury have usually resulted. To prevent this, a number of things have been proposed. Dresses of spun glass have been made, but have not been serviceable. Asbestos fibre has proved to be but little better for this purpose. Dipping the goods in a solution of alum in water has been tried with better success. Other methods have been recommended, such as dipping the fabrics in a solution of tungstate of soda (the best, but rather expensive). About three ounces of a mixture of four parts of borax with three parts of Epsom salt, may be dissolved in from nine to twelve fluid ounces of water, and into this the fabrics can be placed until soaked; then wrung out, dried, and ironed. An English patent is for equal amounts of acetate of lime and chloride of calcium dissolved in twice their weight of water; the goods being treated with this in the same manner as the foregoing.

For information relating to the proper dressing of the feet, see the chapter on the Hands and Feet.—Ed.]

JOHN V. SHOEMAKER, M.D.

HYGIENE—CLIMATE.

BY

ARTHUR H. NICHOLS, M.D.,

OF BOSTON, MASS.,

MEMBER OF THE AMERICAN SOCIAL SCIENCE ASSOCIATION, ETC., ETC.

CLIMATE.

THE term *Climate* is employed to express the various atmospheric phenomena that influence organic existence, both animal and vegetable, and particularly the temperature, humidity barometric pressure, wind, rain, ozone, and the geological nature of the soil.

Temperature.

The greater or less degree of heat to which a country is subject constitutes the controlling agency in influencing climate, this being chiefly determined by its latitude. As a general rule, the greatest degree of heat prevails in countries lying beneath, or close to, the equinoctial line, the temperature decreasing in direct ratio to the distance from that line. There are, however, numerous subordinate phenomena tending to modify the climate of different districts, first of which may be mentioned the agency of large areas of land in the form of continents, which influence climate by distributing heat and thus elevating the temperature. An illustration of this effect of contiguous countries upon temperature, may be had by a comparison of that portion of Europe occupying the temperate latitude, with the corresponding zone in North America. If we trace upon the map the course of the forty-fifth parallel of latitude, we shall find that it traverses the semi-tropical regions of Northern Italy and Southern France, but, crossing the Atlantic, it passes through the centre of Maine, where, for a period of four or five months of each year, the ground is covered with several feet of snow, and through Lower Minnesota, where snow seldom thaws during the winter months, reaching the Pacific at Oregon. Here a milder climate prevails, with a snow-fall of but a few inches; vegetation being about a month in advance of that part of New York occupying the same latitude.

The chief cause of the milder climate of the Eastern hemisphere is the heat proceeding from the warmer land-areas lying south of, and within, the torrid zone. It is well known that large masses of heat transmitted by the sun are accumulated and radiated by the earth in the torrid zone; and since, in the Eastern hemisphere, the

land area within the tropics is much greater than in the Western, the amount of heat received and radiated by Africa, Arabia, and India, situated in the low latitudes, greatly exceeds the quantity accumulated by the corresponding portions of South America, the comparative area of which is much smaller. In like manner, the temperature of the Northern hemisphere is, as a rule, warmer than that of the Southern, on account of its more extended land area. It should be remarked, however, that the climate of certain portions of the coast in both hemispheres is modified not only by the atmospheric currents, but also by the influence of large ocean-currents of heated waters proceeding from the torrid zone. Thus, the climate of England is rendered softer than that of the corresponding land upon the continent of Europe, from the effects of the warm waters of the Gulf Stream ; while a similarly warm current in the Pacific Ocean, called the Kuro Siro, the existence of which was first shown by Commodore Perry, exercises a like influence in moderating the climate of Japan and the islands in the vicinity.

A further comparison of the climates of Europe and the United States will show that both the humidity and the temperature of the atmosphere are influenced by the configuration of the land. It has been found by long-continued observations that three-fourths of the number and force of the winds recorded in the belt lying between 35° and 50° north latitude, come from a westerly direction. In America these westerly aërial currents, laden with moisture evaporated from the North Pacific Ocean, are rendered arid and cool, especially in the colder seasons, by being deflected upward in their passage over the elevated mountain ranges of the Sierra and Rocky Mountains, which, extending in the form of a lofty and almost unbroken barrier along the western coast of the United States, condense suddenly the moisture conveyed in the atmosphere. The consequence is, that while upon the western slope of these mountains the rain-fall exceeds that of any other part of the United States, amounting to sixty-five cubic inches for the year, at points less than two degrees of longitude east of these mountain ranges, the average rain-fall reaches to but seven and one-half cubic inches. The soft, humid breezes from the ocean having, in this manner parted with their heat and moisture at the elevations to which they are carried, the climate of the interior is rendered drier and cooler. On the other hand, the west of Europe, within a corresponding latitude, presents no such lofty wall of table-lands and mountains ; hence the warm, humid sea-atmosphere proceeding from the Gulf Stream is carried, unobstructed and but gradually modified, over the entire continent.

From the above statements it will be seen that *isothermal* lines,

or lines which, as was first indicated by Humboldt, connect places on the earth having the same average temperature, are not necessarily determined by the distance of these places from the equator. Furthermore, while the climate of any given locality is established chiefly by its latitude, it is largely modified by its height and its immediate surroundings—such as large bodies of water, mountains or forests.

Equability.

Another distinguishing feature of the American climate, taken as a whole, as compared with that of Europe, is found in the irregular disturbances and changes that occur in the temperature, humidity (see page 148), quantity of rain, winds, and cloudiness. The climate of Europe is comparatively equable, whereas that of North America is quite the reverse; one result of which is that the prevalent type of vegetation is, in each country, peculiar to itself. At New York, Charleston, St. Louis, and Fort Snelling, the monthly range of temperature is much higher than is found anywhere upon the continent of Europe; while a still greater contrast occurs in the comparative extremes of heat and cold experienced on these two continents in winter and summer. Thus, it has been observed by Humboldt that the climate of New York combines the summer of Rome with the winter of Copenhagen; while at Quebec is found the summer of Paris contrasted with the winter of St. Petersburg. In Europe the winters are warmer and the summers cooler.

This high temperature and dryness of the atmosphere prevailing in the United States, as compared with the low temperature and damp, foggy, cloudy atmosphere of the west of Europe, is extremely favorable to the growth of certain fruits and plants, particularly the apple, wheat, and the better cereals; whereas, owing to the excessive dryness of the atmosphere, English grasses require especial attention south of the latitude of Philadelphia, and are difficult of cultivation under any circumstances south of the 38th parallel. [The latitude of Washington, Louisville, and San Francisco.]

Geological Character of the Soil.

The physical climate of any locality is materially influenced by the character of the soil. In chalky or limestone districts, or where the soil is sandy or gravelly, the rainfall disappears quickly by percolation, leaving the ground dry, and the atmosphere is thus rendered less damp. Localities in which such soils abound are

free from all malarious exhalations. Marshy districts, on the other hand, are proverbially unhealthy, from the fact that they give rise to certain poisonous agents, either the product of vegetable decomposition, or, in accordance with another theory, an exudation from the earth favored by conditions of heat and moisture.

There exists strong evidence for assuming that the unhealthfulness of most regions is directly dependent upon the quantity of undrained land they contain. The history of the Pontine Marshes affords the most striking illustration of the insalubrity of undrained lands. Early in the history of Rome it was ascertained that frequent and extensive epidemics were created by the condition of the immense swampy lands surrounding the city, and under the reign of Appius Claudius an elaborate system of drainage was constructed, by which the water of these swamps was drawn off and conveyed to the Tiber. This sanitary improvement was followed by a speedy disappearance of the marsh fevers. When, however, Rome was invaded by the Goths, the sewers became obstructed and the soil was again filled with water poured down from the surrounding hills, re-establishing the malarious influences, and rendering this region uninhabitable during the summer months even to the present day.

Sandy soils not only absorb rapidly the rain that falls, but also any noxious effluvia that may be contained in the atmosphere. They, moreover, retain their heat for a much longer time than clay soils or garden ground, and on this account they tend to prevent the sudden cooling of the atmosphere which is especially liable to occur shortly after sundown. In this manner, by modifying any sudden changes from heat to cold, sandy soils exercise a considerable influence in rendering the climate more equable, and affording an exemption from those changes of temperature so harmful to the invalid. Those localities in which the soil or subsoil is composed largely of clay, form unhealthy sites for habitation, the air being rendered damp and cold, and productive of rheumatisms, colds, catarrhs, and consumption. (See page 167.)

Forests.

It is rather remarkable in the history of mankind how little has been hitherto understood concerning the beneficent influence exercised upon any locality by the near presence of forests, and the injurious effects that must inevitably follow the wholesale destruction of them, such as has been wantonly committed in the United States during the past quarter of a century. Forests serve

to retain in their leaves, roots, and the surrounding ground, the rain, and thus constitute natural reservoirs of water, which feed our water-courses throughout the summer. By exhaling the watery vapors absorbed by their roots from the earth, they contribute to render the air more humid, and thus moderate the extreme cold of winter and the heat of midsummer ; and when this ascending vapor comes in contact with the higher and cooler layer of the atmosphere, it becomes condensed into clouds, and these in falling, produce frequent refreshing showers in localities which would otherwise suffer for the want of rain. It is estimated that the annual rainfall in certain parts of Egypt has nearly doubled since the attempts by the Khedive to regenerate certain sand-wastes by the systematic planting of date-palms and other trees. Not only have many hundred square miles been in this manner added to the cultivable lands, but the districts adjoining the tree-plantations have been likewise benefited, the midsummer heat being rendered less oppressive ; while currant-bushes and wild mulberries have sprung up in localities where they were never before seen.

Upon the other hand, in districts that have been robbed by man of their forest covering, the land exposed to the direct rays of the sun acquires a temperature more elevated than that of the atmosphere, and becoming heated and dusty, it is after a while deprived of all vestiges of vegetable life, and is no longer capable of sustaining a large population. Instances of the deleterious effects upon the soil and climate, and the consequent partial depopulation of entire districts, produced by the extirpation of forests, are found in the valley of the Euphrates, in China, in Northern Africa, and in very many countries bordering on the Mediterranean Sea ; and there exists every reason for concluding, that, at no very distant period, similar changes will be experienced in Ohio, Michigan, Indiana, and other Western States, where the wholesale destruction of trees has been for years permitted ; unless the attention of legislators should be directed to the dangers impending from this source, and measures be taken to prevent these fertile regions from being rendered sterile and uninhabitable.

To the invalid the presence of forests is, moreover, beneficial in that they have a disinfecting influence upon the surrounding air, absorbing or neutralizing innumerable noxious gases and miasmatic vapors, and giving oxygen and resinous odors. Several instances are upon record where the wholesale levelling of trees has exposed a district to the direct effects of malarial poison, and thus given rise to severe and fatal epidemics ; while the presence of a woodland intervening between an inhabited district and an

unhealthy marsh has afforded an insurmountable barrier to this malarious influence.

Ozone.

The presence, or absence, of ozone in the atmosphere is thought to exercise a powerful influence upon the human organism; but our knowledge concerning the mode of action of this agent, and of the comparative quantity in which it prevails in different localities, is as yet extremely limited. It is supposed to act powerfully by oxidizing and thus rendering innocuous the essential principle of zymotic diseases and putrescent miasmata. In a similar manner, by oxidizing the hydrogen compounds of sulphur, phosphorus, and nitrogen, it possesses the power of destroying the offensive smells produced by decay of animal matter, and of thus preserving the purity of the atmosphere; on which account it has been termed "nature's great deodorizer." It is known to possess the strongest disinfecting power, and has been administered successfully as a remedial agent in the treatment of scarlet fever and diphtheria. It is soluble, to a small extent, in water, and when water is mechanically divided, so as to form spray, it is liberated in large quantities. Hence, near water-falls, and at the sea-side, where the water is driven towards the coast in the form of heavy surf, this gas is found in such abundance as to be appreciable to the sense of smell. [For further description of ozone, see pages 153 and 154.]

Elevation.

Another cause which serves to modify climate is the elevation of the land above the sea-level, a difference of altitude being equivalent, in its effects upon temperature, to a difference in latitude. As we rise above the surface of the sea, the air becomes more and more rarefied, and the degree of heat derived from the sun's rays decreases, until at length a point is reached above which snow and ice are no longer melted—a limit which has been termed the snow-line, or line of perpetual snow. The snow-line of a given place is dependent upon the distance of the place from the equator; being very much higher in warm than in cold countries. In the Andes of South America, situated near the equator, it was found by Humboldt that the height of the snow-line is about 1,600 feet; whereas in Norway, in lat. 60°, the snow-line comes down to a level of about 500 feet, and in 80° of north latitude, the surface of the earth is covered with snow all the year round.

In temperate climates this progressive lowering of temperature amounts, with occasional variations, to about ten degrees for every 300 feet of vertical ascent. It is commonly considered that life on an elevation offers hygienic advantages, and this popular notion is supported by many unquestionable facts. It has long been known, for instance, that land at a height of 1,000 feet above the Campagna of Rome offers immunity from the miasms infecting the districts below; also, that a large class of invalids obtain relief by retiring to certain moderately elevated regions of the Alps or White Mountains.

Undoubtedly the total of the climatic conditions of numerous mountain resorts is favorable, for the atmosphere of these regions being clear, dry, and bracing, and free from dust, smoke, and those organic particles which upon the earth's surface are thought to play so important a part in favoring putrefactive changes, the mental and muscular powers increase in activity and strength: the functions of respiration are also increased, as well as the secretions from the skin and intestines; the appetite is excited, and as digestion becomes more complete there is a proportionate gain in physical strength, and the entire organism appears revivified.

The beneficial influence of this antiseptic mountain air does not prevail, however, above a certain elevation. We learn from aëronauts and mountain travellers that on ascending to very high regions they are to subject characteristic sensations and discomforts, the result of the diminution of the barometric pressure, and of the lower temperature. These symptoms, which have been comprehended under the term "mountain sickness," consist of an increased frequency of respiration, palpitation of the heart, distention of the arteries especially those of the head, dizziness, dimness of vision, nausea, nervous and muscular weakness, and ever-increasing difficulty in respiration, which, if unrelieved, may cause death by asphyxia. These derangements are produced by the imperfect oxidation of the blood in the rarefied air, the proportion of oxygen decreasing as the barometric pressure is diminished. [See page 143.] The symptoms are greatly aggravated in a very low temperature, or upon any attempt to climb or even walk about; being less severe in a warm air, or if the traveller remains perfectly quiet, as the blood demands less oxygen when the air is warm or the body is at rest. The favorable hygienic influences are therefore to be found only at moderately elevated regions, while, from the modifications of barometric pressure that prevail at very great altitudes, the blood, insufficiently supplied with oxygen, becomes impoverished, and prolonged existence is thereby rendered impossible.

Winds.

In addition to the general currents which lower or raise the temperature by transporting the atmospheric peculiarities of one country to another, there is a great difference in the force of the wind of different localities upon the same continent, due to the topographical character of the places, whereby the climate is sensibly influenced. At a low temperature the body will be deprived of its heat at a much more rapid rate when the wind is high than when it is calm. Hence the advantage of a moderately calm climate, where the invalid, especially one subject to bronchial irritation, to whom high wind is especially injurious, is enabled to take exercise in the open air in a comparatively low temperature.

In certain exposed and elevated regions the force and frequency of the prevailing winds is so great that trees are stunted and forced to grow to the leeward, while other localities, sheltered by high hills, possess a remarkably calm and still atmosphere, having a soothing, sedative effect upon invalids. Deep valleys that admit the rays of the sun for a few hours only each day, are unhealthy as places of residence, for here the air, being confined, becomes loaded with damp, malarious exhalations and vapors, such as would speedily be dispersed if exposed to sunshine and free circulation of air.

Influence of Climate in Disease.

Although the beneficial influence of a change of climate has long been recognized, the hardships which formerly attended even the best modes of travelling prevented most invalids from availing themselves of this important agent. The use of steam as a motor power has, however, made wonderful changes in this respect, and as one of the marked results of this improvement in travelling facilities, we see the vast watering-places that abound in Europe and the United States, and the relatively deserted state of large cities during the heated season.

The most marked effects are frequently produced by a change of residence, even though the distance be not great—such as a removal from a low, swampy region to one more elevated; from the insalubrious and depressing conditions of a crowded city to the open country; from the country to the sea-shore, or *vice versa.* In the treatment of various diseases—such, for instance, as whooping-cough, asthma, intermittent fever, and affections characterized by dyspepsia, no more beneficial results can be obtained than those derived from a judicious change of air, under the influence of

which the action of other remedial agents is often rendered more efficacious. In other diseases, and particularly in lung troubles, by a more complete change of climate, the malady, if threatening, may be warded off; or, if actually existing, may be cured; and even in less fortunate cases, where an unfavorable result is inevitable, the progress of a fatal disease may be indefinitely postponed, and life prolonged for years, where such change is admissible. It should be borne in mind, however, that no air or climate possesses any *specific* properties by virtue of which diseases are cured, though certain localities, such as Aiken, South Carolina, or Bournemouth, England, or the Isle of Pines, lying south of Cuba, derive a special character from having an atmosphere impregnated with resinous and balsamic odors, which are thought to exercise a favorable influence in certain disorders of the air-passages.

The advantage to be gained by transition from a cold and damp to a warm and dry region, or from a changeable to an equable climate, is to be ascribed in a great measure to the fact that it allows the invalid to pass a portion of the day in the open air, when, were he to remain at home, he would be shut up, perhaps for the entire winter, in the insalubrious air of artificially-heated apartments, deprived of proper exercise, and exposed to the drafts of cold halls—conditions tending to the production of indigestion, fatty degeneration of the entire muscular system, hypochondriasis, and a general aggravation of pre-existing disorders. There exists in even the most serious maladies a natural tendency to spontaneous cure; and this tendency, which is favored by exposure to the sun and air, is checked by prolonged in-door confinement. Let the invalid be removed from the manifold depressing influences inseparable from our large cities, and placed in a climate where he can enjoy daily exercise in the open air without incurring the risk of taking fresh colds, and the constitution is improved, and the normal healthy condition restored, often without any further treatment. There are offered, moreover, obvious advantages in a bright atmosphere and cloudless sky, while the numerous objects of interest found in Southern Europe, and especially in Italy, combine to entertain the invalid and divert his mind from cares, anxieties, and gloomy forebodings, substituting gayness and brightness of spirits—influences more potent in their effect upon the animal functions than is commonly appreciated.

When a change of climate has been decided upon, it remains for the medical attendant to determine the climate best adapted to the constitution and condition of the invalid, and the special disorder from which he is suffering. Nor is it always sufficient that the simple injunction be given to go South; for a locality that may

be beneficial to one variety of cases may be positively injurious to others. It not unfrequently happens that, owing to the formation of the soil and the local surroundings, the air of one resort produces a very different therapeutic effect from that of another, although the distance between the two places is comparatively short. Thus the winter and spring climate of St. Augustine and Jacksonville, Florida, owing to their topographical position upon the low seacoast, is humid, hot, and relaxing, like that of the Bahamas, the Bermudas, and the West Indies ; whereas the sand-hill regions of South Carolina and Georgia, and the high land of Colorado, possess a drier, cooler, and more stimulating air.

The invalid, having selected his new residence, must avoid, moreover, the common mistake of imagining that he can trust to the unaided powers of climate, to the neglect of other things of equal importance ; but he must keep constantly in mind that unceasing precautions are necessary if he would secure the full remedial advantages of the change. In order to accomplish the object of his journey—the restoration of his health—he must not only avail himself of all the advantages offered by his new abode, but also eschew the disadvantages from which even the best climates are not altogether free, for no place has as yet been discovered which possesses all the physical qualities that can be desired. First of all, it is essential that rooms be chosen in a situation exposed to the sun, taking care to avoid localities that are damp, over-shaded, or near bodies of stagnant water. Insalubrious conditions of this character not only interfere with the improvement of the sick, but may even prove the cause of some new disease. Facilities should be furnished for having an open fire within the apartment, to serve for supplying heat in case of cold weather, for drying the air, and thus counteracting the effect of any excessive dampness, and for producing ventilation.

In changing to a warmer climate, it is well to remember that a lighter and less stimulating diet is required, and an appropriate dietetic regimen should, therefore, be adopted at the outset, and rigidly adhered to. The patient must be constantly on guard against exposure to sudden changes, as well as the night air, which even in the best selected climates may be insalubrious. Although it may be desirable to dispense, as far as possible, with the use of medicines, these may, for a while, be necessary for the relief of urgent symptoms, especially the increased fever, nervousness, and sleeplessness that are liable to supervene immediately after his arrival, attributable to the reaction following the fatigue and excitement of the journey. He should, moreover, avail himself of all the special advantages the place may afford. If in the

vicinity of the sea, very great benefit may often be obtained from a daily ocean bath, followed by frictions, and taken with other precautions mentioned elsewhere. [See page 253.]

Many winter resorts have obtained celebrity on account of the possession of mineral springs, and permanent benefit may, in some cases, be afforded by combining the change of climate with a judicious course of mineral waters. [See page 371.]

Varieties of Climate.

Climates may be classified, so far as their influence upon the invalid is concerned, into: 1. Irritant; 2. Tonic or bracing; and 3. Atonic or relaxing.

1. *Irritant climates* are characterized by the prevalence, during the greater or lesser portion of the year, of a disagreeable, penetrating wind, that exerts a deleterious effect upon the human organism, deranging the nervous system, depressing the spirits, and tending to induce and aggravate many maladies. In New England, during the spring months, these winds, coming from the northeast, are raw and cold, causing rheumatism and pulmonary diseases. In England they come from the east. In Spain, and the French valleys of the Pyrenees, a hot, irritating air blows from the south; while in Italy, a cold north wind, called the Tra Montana, is the cause of much discomfort to both the healthy and the diseased.*

2. *Tonic climates* are such as produce a stimulating, bracing effect upon the body, exciting the functions of the animal economy and producing buoyancy of spirits. This favorable, health-giving influence seems to be dependent chiefly upon moderate dryness of the atmosphere, combined with a clear, sunny sky, which favors the exhalations from the lungs and skin, and permits daily exercise in the open air. The temperature of a tonic climate may be either very low, as in Colorado and Minnesota during the winter, or extremely hot, as in the Spanish Peninsula during the summer; provided only that the air be dry, the exhilarating, strengthening influence is none the less marked.

3. *Atonic* or *relaxing* climates are characterized by the habitual presence of a large amount of moisture in the atmosphere com-

---

* [A similar cold north wind, which has been deprived of its moisture by passing over mountains, is, in Southern France, called the Mistral; and in Texas and Arizona "Northers," as they are there called, which have lost their moisture during their passage over broad tracts of desert country, cause great suffering during their continuance. —Ed.]

bined with a high temperature. They tend to produce a feeling of bodily lassitude and mental depression, and also to induce an aggravating internal congestion and inflammation. Examples of this variety of climate may be found in Florida, Cuba, the Bahama and Bermuda Islands, Rome, Pisa, and Palermo.

It is generally agreed by medical writers that the great majority of invalids suffering from general debility, pulmonary disease (whether incipient or advanced), disordered digestion, rheumatism or nervous derangements characterized by torpidity, derive the most benefit by removal to a tonic, bracing climate, which is likewise appropriate for persons suffering from no special ailment, but who seek merely change of air and relaxation from the routine of business life, or who have made imperfect recoveries after fevers.

The atonic, sedative climates, on the other hand, which commonly disagree with those persons visiting them in good health, prove beneficial chiefly in certain diseases of the nervous system characterized by excitability and irritability, not associated with much debility; in the debility of old age, in which an enfeebled circulation fails to supply the requisite animal heat; and in certain affections of the lungs, accompanied by a hard, irritable, or spasmodic cough, with scanty, viscid expectoration.

The principal sanitaria located in the southern portions of Europe and North America, are resorted to only from November until June, invalids being then compelled, by the relaxing, oppressive heat, to return north, where, during the warm months, the weather is generally propitious. If, however, a permanent abode is desired where the same favorable influences prevail throughout the year, it is doubtful if any places enjoy a greater hygienic pre-eminence than the islands of the eastern Atlantic, which were celebrated even among the ancients for their mild and equable climate. These islands occupy a much more favorable geographical position than those of the western Atlantic, while their lofty conformation and luxurious vegetation tend to influence their climate and render them much cooler in summer. They consequently present very great advantages over the best resorts in Europe or America.

The islands of *Madeira* and *Teneriffe* have long been held in high estimation on account of their exceptionally favorable climatic conditions, and it is improbable that any health resort can ever be found approaching nearer to perfection, as a place of permanent residence, than the town of Oratava, situated upon the latter island. The characteristics of this place are its mild, equable temperature, its freedom from epidemic diseases, fogs, and frosts, and the rare occurrence of winds and storms. The mean

temperature of the five cooler months (November to March) is 64° Fahr., that of February, the coldest month, being 62.1° Fahr., and that of the three warmest months (June, July, and August) being 77° Fahr. The mean temperature of the five winter months at Rome and Nice is 50° Fahr. Oratava enjoys not only a mild winter and a cool summer, but there is also found a remarkable equality of temperature during the day and night. A high mountain range protects the town from the hot currents proceeding from Africa, and the heat of summer is furthermore tempered by the sea-breezes that set in during each forenoon, and by the vapors from the Atlantic, which serve to intercept the direct rays of the sun, so that the early hours of morning differ only 6° to 9° Fahr. from the heat of mid-day. The average number of rainy days is 45, that of Rome being 114, while the barometer stands almost invariably at 30.12 inches. In this climate of perpetual spring the invalid can live throughout the year in the open air, and under the most favorable hygienic conditions.

In pulmonary affections especially, the sufferer, freed from the depressing influences of artificially-heated and poorly-ventilated apartments, and no longer exposed to the impure emanations inseparable from large cities, soon gives evidence of the revivifying effect of a pure, mild atmosphere and sunny sky. In cold, humid climates, however great care may be taken to maintain within doors an equable temperature—the enfeebled lungs are inevitably exposed to cold drafts, sudden atmospheric changes and irritable winds, adverse influences which either interfere with recovery or aggravate the original complaint—while the invalid, deprived of exercise, becomes depressed and hypochondriacal, and the supervention of dyspepsia, or some other new disorder, serves to dispel all hopes of improvement. In a favored climate, however, like that of Oratava, the lungs, relieved of all extra labor, obtain fair play and that partial rest so necessary to enable the animal economy to resume its normal functions and throw off disease. In appropriate cases, where the disease is not too far advanced, the spirits speedily revive by the change, the cough and expectoration diminish, night sweats abate, and a favorable prospect is held out of gradual, spontaneous recovery, which, in a fair proportion of cases, is ultimately realized.

It is only in exceptional cases, however, that any such radical change of climate is essential to effect a cure, the great majority of cases obtaining sufficient benefit from the protection derived from a resort to the more accessible sanitaria of Europe and America. Of these the watering-places of southern Europe offer superior advantages in the way of hotel accommodations, hygienic

cookery, society, picture-galleries, theatres, club-rooms, and other sources of mental diversion—all valuable adjuncts in the treatment of the despondent, depressed invalid. The absence of such sources of diversion in American resorts, combined with their lack of easy accessibility and the small degree of attention paid by hotel proprietors to gastronomical science, has hitherto rendered them unattractive to visitors, especially to those whose digestive functions are imperfectly performed. Within a few years, however, the revolutions in the character of some of the larger health resorts of the Southern States, and the improved facilities for travel, have served to divert to a large extent the tide of European travel. The invalid can now travel in one comfortable vehicle from Boston to Southern Virginia within but little over twenty-four hours' time ; while at the more frequented sanitaria—and notably at Aiken, South Carolina, and at Jacksonville and St. Augustine, Florida—may be found commodious hotels furnished with good taste, and capable of supplying a sound, well-ordered repast, comparing favorably, as regards the variety and quality of the food, with the best hotels of the North.

In choosing a health resort, we should, then, endeavor to ascertain, as far as possible, the special agents influencing different localities, such as altitude, the neighborhood of the sea, the character of the soil, the amount of rainfall, the shelter from disagreeable winds, and other factors. A thorough acquaintance with these peculiarities can only be obtained from works containing detailed descriptions of these various resorts ; we can here give only a brief summary of the chief features of some of the most noted sanitaria accessible to Americans, premising, by the statement, that the published accounts are in many instances meagre and unsatisfactory from the fact that they are not based upon carefully observed meteorological phenomena.

Asheville, North Carolina, may be mentioned as the type of those moderately dry, tonic sanitaria, occupying the mountainous districts of North Carolina, Georgia, and Eastern Tennessee which derive special character from an altitude much higher than that of the other resorts of the South-Eastern States. This high situation—more than 2,000 feet above the sea-level—offers a magnificent climate during the autumn and spring, and tempers the heat of summer to such an extent that invalids can remain here with comfort throughout the year : the mean temperature of the winter months is low, however, as compared with more Southern localities.

Aiken, South Carolina, has for several years enjoyed a high reputation for salubrity, and is now said to be one of the most fre-

quented of the winter resorts of the United States. It is very attractively situated on the brow of a hill at an elevation of six hundred feet above the sea, and is surrounded by immense evergreen pine forests. Its climatic characteristics are its pure, tonic, exhilarating air, and its absolute freedom from malarial affections ; the loose porous soil secures good drainage and serves to render the air dry. The mean temperature of the months of November, December, and January, is 48.53° Fahr., that of Asheville being nearly eight degrees colder. In its physical qualities the climate of Aiken resembles, in all essential particulars, that of Mentone, Nice, Pau, and the other resorts of Southern Europe, but is, like other American resorts, less equable, although enjoying greater immunity from rainy weather. This town is well supplied with excellent hotels and boarding places, and is suitable to the generality of invalids suffering from pulmonary complaints, derangement of the digestive system, or general debility without any special ailment. The season extends from November to April inclusive.

Thomasville, Georgia, has become extensively and favorably known within the past few years as a resort for consumptive patients, but meteorological data are as yet wanting which would enable us to classify it accurately among the health resorts. Like Aiken, it has a high elevation, with a loose, sandy soil, in the midst of evergreen pine forests, and is said to possess a winter temperature somewhat milder, but less dry, than that of the latter place.

Florida. This flat peninsula, occupying a low latitude, and, for the most part, raised comparatively but a few feet above the sea, presents a sunny, genial climate during the winter months, considerably warmer and more humid than the resorts of the Northern Mediterranean. *St. Augustine* is finely situated upon the coast, and is rendered especially attractive by its remarkable historical associations. *Jacksonville,* near the mouth of the St. John's River, a city of about fourteen thousand inhabitants, offers superior hotels and refined society. The atmosphere of these two localities is warm and moist and of special benefit in certain nervous and bronchial affections. Owing, however, to the mixture of land- and sea-air and other local influences, consumptives are usually advised to repair to the more elevated towns upon the St. John's, such as *Magnolia*, *Palatka*, and *Enterprise*, where the climate is still milder but less variable and humid. The malarial character, however, of this entire district renders it an unsafe abode for visitors during the summer months.

Nassau, upon New Providence, one of the Bahama Islands, is charmingly situated near the confines of the tropics, and pos-

sesses, probably, the most equable climate of any of the American sanitaria, the temperature for a period of years not having risen above 88° Fahr., nor fallen below 60° Fahr. During the winter months, bright, clear weather, with little or no rain, abounds, the only drawback being the humidity of the atmosphere and the somewhat relaxing character of the climate, common to most semi-tropical resorts. A public library, an excellent hotel, built by the English Government, and fine, well-kept roads, all contribute to the diversion and comfort of strangers.

San Antonio may be considered the best known resort of the region which includes the high table-lands of Texas and New Mexico, and is now annually visited by large numbers in search of health. Its distinguishing climatic feature is its mild, dry, stimulating air. It is subject, however, to great range of temperature, and being quite unprotected by any mountain ranges from the cold, dry, piercing winds which sweep the continent from the north, the invalid will be frequently compelled to keep within doors during the winter.

The climate of the highly elevated district of *Colorado*, occupying the upland plateau of the Rocky Mountains, has recently become favorably known, owing to its beneficial influence upon many classes of invalids. While congenial and exhilarating to persons in sound health, it is especially recommended during the winter to those suffering from incipient pulmonary affections, when the local disease is not extensive, and in disorders originating in imperfect nutrition, or from long-continued overwork and mental anxiety. This region, so dissimilar to that of the European sanitaria, owes its climatic characteristics to its peculiar geographical situation, the principal towns being located at an elevation of above 5,000 and even 6,000 feet above the sea-level, which, combined with the distance from large bodies of water, tends to produce an extremely dry and bracing atmosphere. Although the winters are quite cold, the average temperature for a period of five years being 29.1° Fahr., in this rarified atmosphere, with an almost uninterrupted prevalence of bright, clear sky, the cold does not form a deleterious or even disagreeable feature, since it is counterbalanced by the increased heat derived from the sun, the bracing, invigorating influence of the mountain air, and the shelter from strong winds afforded by the adjacent lofty mountain ranges. No rain and but little snow fall during the winter, the ground being for the most part bare. Severe storms are of very rare occurrence, but abrupt, extreme alternations of temperature are common. As a summer residence it is healthy and safe.

The principal resorts are *Denver*, a city of 20,000 inhabitants;

Manitou, near Pike's Peak, noted for its thermal springs and charming situation, at an altitude of 6,370 feet above the sea-level; *Idaho Springs*, having an elevation of 7,540 feet; *Colorado Springs*, and *Pueblo*.

[*Minnesota*.—The vicinity of St. Paul, on the Upper Mississippi, has long been known as affording good climatic conditions for many cases of illness. The distinctive feature is a dry, cool atmosphere during the entire year. Although the climate acts powerfully as a tonic, the intensity of the cold in winter prevents it being of service to those whose circulation is poor, and whose vital heat is not easily kept up.—Ed.]

California possesses great diversity of climate, but that of the southern portion of the State, which forms the resort of invalids, is probably the most favored of all North America, and is as capable of meeting the requirements and peculiarities of every variety of disease, as any locality in Europe. The situation of *Santa Barbara*, embosomed in a valley overlooking the ocean and sheltered from cold winds by the mountain-ranges which hem it in upon the north, renders it a remarkable winter resort, its climate being equable, mild, and relatively dry. *San Diego*, also upon the coast, bears a close resemblance in its climate to *Santa Barbara*, the mean temperature of each place being 53° F. for the month of January. The climate of *San Bernardino*, situated in the interior, at an altitude of 1,000 feet, offers the advantage of a dryer atmosphere than that of the last-mentioned resorts, and being cooler in summer and enjoying an immunity from the fogs which then prevail in the vicinity of the sea-coast, affords, throughout the year, a genial, salubrious residence.

[The *Ojai Valley*, about forty-five miles north-eastward of Santa Barbara, is considered by California physicians to be a more favorable residence for persons having pulmonary troubles than is Santa Barbara itself, and many persons from the Eastern States have already resorted to it with benefit.—Ed.]

It is a serious error, however, to imagine that diseases in all stages are amenable to a change of climate. It is well to understand that when there exists advanced chronic disease of any organ, the fatigue and excitement incident to a long journey may often produce, in a susceptible person, attacks of acute fever, and possibly some new inflammatory affections, which may more than counterbalance any possible benefit derived from a short residence even in the most appropriate climate. Unfortunate is the lot of the expatriated invalid when left unattended in France or Italy, where an unfamiliarity with the language and customs, combined with physical helplessness, render him a feeble victim to

the cupidity of unscrupulous landlords, and subject him to numerous petty annoyances, not the least of which is the consciousness that even his death will afford but a pretext for new and preposterous claims. It will often happen, therefore, that the extreme physical weakness or susceptibility of the invalid, or the advanced character of the disease, or a lack of pecuniary means, renders any decided change of climate inexpedient or impracticable. Such a one may be reminded that even in his own home something can still be done to mitigate urgent symptoms and prolong existence, by taking the necessary precautions to maintain within doors an equable temperature and thorough ventilation, and indulgence in such exercise as his strength and the weather may permit, combined with daily salt-baths, either tepid or cold ; by which means the activity of the cutaneous circulation is promoted and the appetite and digestive functions stimulated. Even when a fatal termination is inevitable, that result will be awaited with less trepidation if the tranquillizing assurance can be had that the last days are to be cheered by home comforts, and the consoling presence and attention of those rendered dear by the ties of kindred and friendship.

ARTHUR H. NICHOLS, M.D.

Hygiene—Exercise.

BY

JOHN V. SHOEMAKER, A.M., M.D.,

OF PHILADELPHIA, PA.,

LECTURER ON DERMATOLOGY AT THE PHILADELPHIA SCHOOL OF ANATOMY; PHYSICIAN TO THE PENNSYLVANIA FREE DISPENSARY FOR SKIN DISEASES, ETC., ETC.

EXERCISE.

THE healthy condition of the body can only be preserved by maintaining the different organs in a state of activity. *Exercise* is usually understood to be the systematic action of those muscles that are under the control of the will; but this is in reality a restricted meaning of the term. The mind as well as the body requires for its healthy development a certain amount of activity, and the failure of certain systems of muscular action is due to the fact that they awaken in the mind no interest or excitement. Further, some of them, although calling into play a great variety of muscles, and awakening interest when first undertaken, are by their uniformity and artificiality liable to become painfully monotonous. If an individual be forced to perform a certain amount of work, the novelty may at first please, but the continued repetition produces, ultimately, a feeling of disgust, and in this latter state he endeavors to avoid the labor, or will perform it imperfectly and listlessly. In this fact is believed to rest the reason of the failure of some forms of routine labor which, in theory, promise so well.

In the lower types of mankind, such as the savage and semi-savage states, the habits of life secure all the activity that the individual requires. Among the North American Indians and the Bedouin Arabs, who live a wandering life, mostly in the open air—the men engaged in the chase, the women performing the manual labors of agriculture and of household duties—both sexes live in continual activity, and enjoy its advantages. In civilized countries, under the opportunities for ease and quiet, the nature of man succumbs to these temptations, and, as a result, we have a long train of evils, among which may be noted: diminution of muscular tissue, accumulation of fat, overcharged condition of the circulation, and disorders of certain viscera, particularly of the stomach and liver. With a proper amount of activity the muscles become firm and well developed; the fat disappears from all parts except where it is necessary; the circulation is active

but not plethoric, and the functions of all the internal organs are properly performed.

It is necessary, therefore, for each person to perform a certain amount of work, even if it be merely for the purpose of calling the muscles into action. In such trades as occupy both body and mind, the work done is sufficient exercise ; but in sedentary occupations, and among professional men, and, indeed, for all whose daily duty is rather to use the mind than the body, the necessity for some artificial exercise is urgent.

In certain diseases we see striking proofs of the truth of the above statements. When paralysis of a limb arises from a disease of the central nervous system, the loss of motion may be due solely to the inability of these nerve-centres to originate the impulse, and the muscles may, by inactivity, slowly waste away. In such cases much good may be done, in the way of preserving the fulness and proper development of the limbs, by artificially stimulating the muscles, as by an electrical current.

Above all things, it must be borne in mind that exercise is not beneficial when it causes fatigue. The practice of indulging in gymnastics, rowing, skating, or swimming, until the individual is weak and exhausted, is a habit that is not only foolish but injurious, and by such conduct one may easily lose all the advantages of the exercise.

Character of Exercise.—Exercise may be light or heavy, that is, may cause the muscles to move without any great effort, or may tax them considerably. Opinion has for some time been divided as to the relative merits of these two systems. Without entering at any length into the dispute, it will be of advantage to say a few words as to the applicability of both methods. For those of vigorous constitution and good muscular development, who seek to maintain this condition, it is best that the work to be done should require some energy. When powerful muscular effort can be borne without injury, its effect is strikingly beneficial. The finest examples of general *physique* are presented by blacksmiths' helpers who swing a heavy hammer, or by those employed in iron-works, who are engaged in lifting heavy castings. These labors and the corresponding exertion required in using heavy dumb-bells, are safe only for those already well developed ; persons of moderate strength may easily overstrain their muscles or produce ruptures. For this reason the general opinion of authorities leans to those methods which tax only slightly the muscular system ; the efficacy of the action depending rather upon its frequent repetition than upon the strength exerted.

It may happen that only a certain set of muscles require atten-

tion, but in general the preferable forms of exercise are those by which a large number are called into play.

We may now consider in detail the practical points in regard to the several standard systems of exercise.

1. **Gymnastics.**—This method, consisting, as is well known, of feats in climbing, leaping, swinging, supporting and raising the body, etc., has undoubtedly been of great benefit to many persons, especially to students. Most colleges and large schools have recognized this fact and erected gymnasia. Excepting the tendency on the part of beginners, or those fond of display, to over-exert themselves, the gymnasium is a safe and effective method. The principal objections to it are, the artificial and monotonous character of the exercise, and that it is generally in-doors. Indeed, the monotony of all indoor exercises constitutes a serious difficulty. However much the person may at first like the labor, and however much he may appreciate the necessity for it, the continued repetition, at stated times and for stated periods, of a routine of actions which are purposeless in themselves, will develop a distaste which will ultimately lead to its abandonment. Besides this, gymnasia may be badly ventilated, and the injury done by inhaling foul air may counterbalance the good otherwise produced.

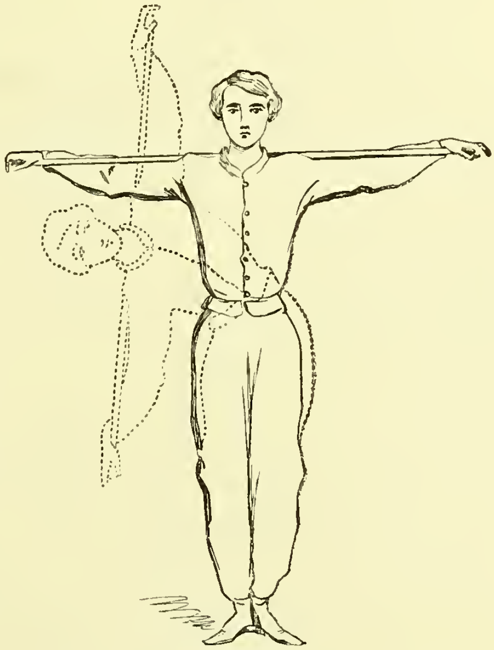


FIGURE 152.

The gymnasium offers us a convenient means of developing special muscles which, either naturally or by acquired habit, are not brought into frequent action. Among the errors common to young adults, and especially to young men, is that of allowing the shoulders to fall forward and inward, giving to the person the well-known stooping posture. This position restricts the inflation of the lung, especially at the apex, and undoubtedly constitutes an additional predisposition to pulmonary disease. Consumption generally appears first at the apex of the lung, and it has been in-

geniously suggested that this occurs because that part of the organ,

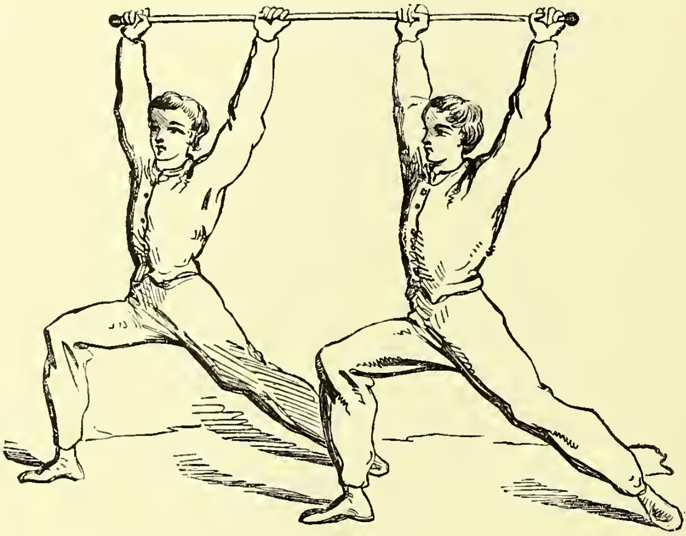


FIGURE 153.

being least exercised, is least vigorous. At any rate, a form of exercise which counteracts this tendency is to be encouraged. Such,

FIGURE 154.

for instance, is the use of the wand shown in Fig. 152. Of similar

effect, in the main, will be the action shown in Figs. 153, 154, 155,

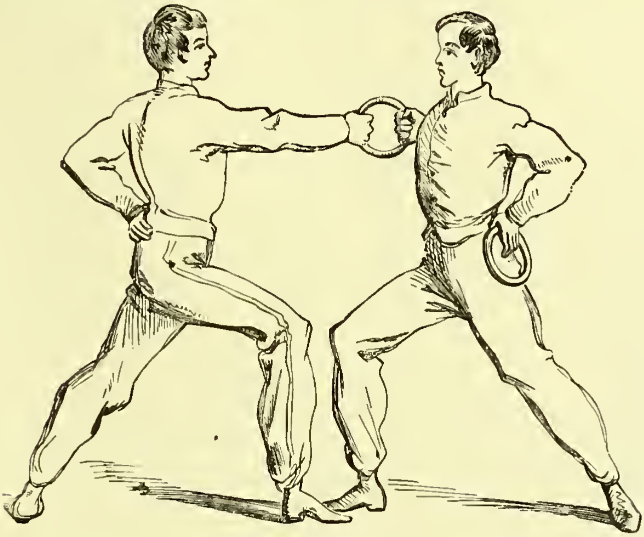


FIGURE 155.

and 156.* These all throw into action the erecting muscles of the back and shoulder, and compel the inflation of the chest.

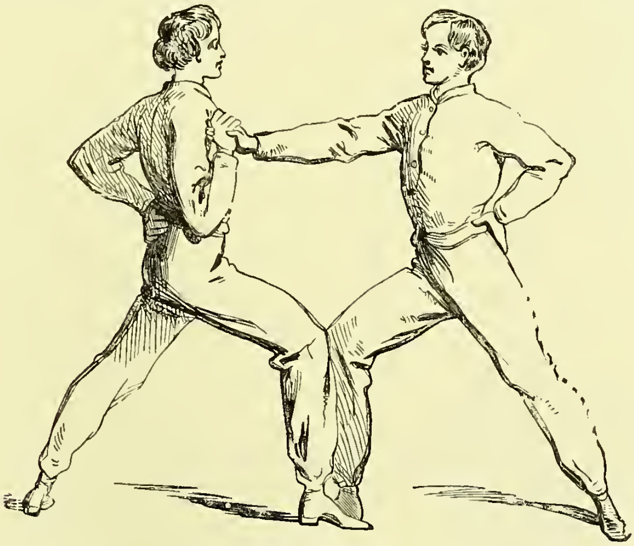


FIGURE 156.

Attention may be particularly called to the exercise represented

* These figures are from the "Hand-Book of Calisthenics and Gymnastics for Schools, Families and Gymnasiums, with Music to Accompany the Exercises." By J. Madison Watson. Published in New York.

by Figs. 153 (155 and 156), in which two persons may take part, and thus not only relieve monotony, but, by developing a mild spirit of rivalry, add a new zest to the work.

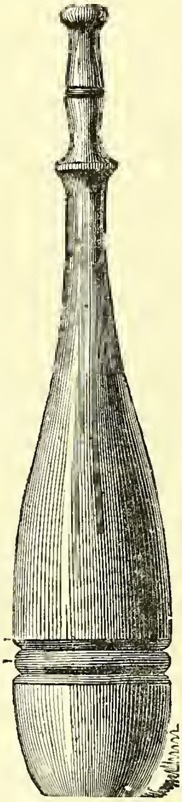


Figure 157.—Indian-club.

Of the light gymnastics the *Indian club* exercise is one of the best. Indian clubs are bottle-shaped masses of wood, weighing from, say four to ten pounds, the narrow end being convenient for being grasped in the hand. They are held one in each hand, and swung in a variety of curves around the head and shoulders. Certain standard motions or "figures" are given by teachers, but a little ingenuity will devise many forms of movement. A little practice is required to get the movements properly, and the first exercise will quickly fatigue. Six pounds is about as large a weight as should be employed by a beginner.

In kindergartens and girls' schools a still lighter form of exercise—that with *wooden dumb-bells*, is much used. The use of these requires very little muscular effort, and, forming as it does, part of the regular lessons, the work must quickly become monotonous. It is doubtful whether much actual increase of muscular strength is produced by these methods. Indeed, with young children, it is probable that their naturally active dispositions will secure sufficient exercise, especially when allowed opportunities for out-door play. With girls especially, we should encourage out-door games, such as moderate rope-jumping, in the practice of which a lively mental interest will be developed. Much more good will be done by

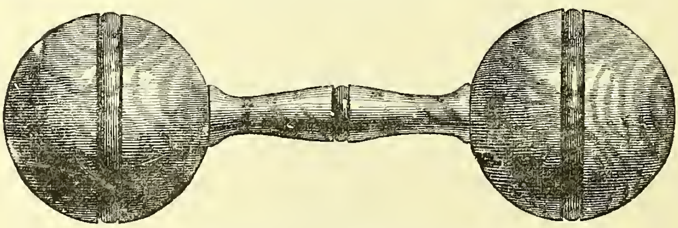


Figure 158.—Wooden dumb-bells.

such a system than by one which, coming at certain hours of the day, and conducted with studied regularity, is soon regarded by the scholar as a task or even as a punishment. The same may

be said of certain recent additions to the means of in-door amusements—the *rubber-band apparatus* and the *parlor rowing and skating*. The value of any of these may be said to depend upon the degree of interest which they excite. They are, no doubt, partly effective, but soon become uninteresting and are abandoned.

Truly healthful exercises are those which can be indulged in out of doors, and especially those forms which involve change of scene. In this catalogue we rank riding, walking, swimming, rowing, ball-playing, and we might add the recently developed fashion of velocipede-riding. Skating, sliding, sledding, and other winter sports are of the same general value, but are so dependent on weather and climate that we need say but little about them.

Riding is not calculated to develop the muscular system to any great extent. Heavy riding, such as hunting or steeple-chasing, may benefit the chest and chest-muscles, but carriage riding and ordinary bridle driving are, in the main, passive exertions. They are especially suited to invalids, securing for them mild muscular effort, fresh air, and lively mental impressions. In most cases an uncovered carriage is to be preferred, as it allows for the rider the benefit of the sun's rays, the hygienic value of which is too often ignored. Close carriages, such as coupés and cabs, are very unsatisfactory, as the heavy upholstering absorbs organic matter, disease germs, etc., and being, as a rule, entirely without ventilation, a long ride in such a vehicle is of no advantage.

Velocipede-riding has attracted some attention of late years. It would be well if it would come into somewhat extended practice in order that its merits and demerits might be determined. It exercises actively the lower limbs and, by a modification of the apparatus, the upper limbs might also be brought into play. The position of the rider is somewhat constrained, and his body is not supported properly. There is some little danger that injury might be done to some of the pelvic organs by much riding on the velocipede as ordinarily constructed.

Walking is an excellent exercise. It develops a large number of muscles, possesses endless variety, and can be graduated with the utmost nicety to the condition of the individual. It would, however, be a sad mistake to ascribe these advantages to the miserable exhibitions of pedestrianism which have been lately so popular. Walking can never be beneficial when it consists in trudging wearily for a certain number of hours around a circle of sawdust strewn on the floor of a badly ventilated, badly warmed, and perhaps crowded hall. The results of the late exhibitions of

this kind prove that a "walking match" is very far from possessing the conditions of true exercise. It is merely a cruel and exhausting trial of strength. Exercise can never be beneficial when it is a test of endurance.

In order that walking may be both enjoyable and beneficial several points must be attended to. The dress should be proportioned to the temperature, the shoes should be broad and comfortable, the head covering should be light. In the hottest weather it may be necessary to keep in the shade, but whenever possible the pedestrian should walk in the sun. A company of two or three make the walk more agreeable, and the route should be a little hilly. Walking on a level is monotonous and exercises fewer muscles.

It has been stated that much walking may produce neuralgias of the legs, and it is very certain that it will bring on a muscular fatigue which will give considerable pain and annoyance. This result, I think, is most likely to follow from walking on inelastic city pavements, and it is likewise due, in some cases, to standing quietly for considerable periods, as is necessary in some occupations, thus putting the same set of muscles on the strain for a long time.

Rowing has become very popular of late, and at some of our colleges the attention which has been given to it by students has been so great as to interfere with proper study. It has many advantages as a means of exercise. It brings into action a large number of muscles, and will, of necessity, be carried on under pleasant surroundings. The muscular effort is by no means limited to the arms ; the skilful oarsman employs very effectively the muscles of the back and legs. This is often shown by the sense of fatigue which is felt in these muscles when more than a proper amount of the exercise has been taken. The benefits of rowing are, however, often lost by incorrect methods. Rowing is a mechanical operation, which, to be properly done, requires careful training. Inexperienced persons will quickly exhaust themselves, and will derive no benefit from the labor. Without desiring to give an essay upon the use of the oar, it will be proper to notice a few points which are essential to making the exercise beneficial. The first point is, that the labor should be performed very largely by the muscles of the back. The body should be bent far forward at the hips, the arms stretched directly forward, and the oar rested in the water. The stroke should be made by drawing the body to an upright position, and even carrying it a little beyond, so as to be bent backward at the hips ; then, and not till then, the arms must be drawn up so as to bring the hands close to the chest. The com-

mon error of beginners is to work entirely with the arms. By such action the stroke will be short and jerky, and the strength of the oarsman quickly exhausted, while, if the proper system be followed, the oar will move with a long and graceful sweep, the effect will be steady and powerful, and the muscular effort will be distributed in such a way as to permit of considerable work without fatigue. The advantages of rowing are in part lost by the unsuitable boats, such as are used by clubs and professional oarsmen. Among the modern improvements adopted in these boats, is the contrivance known as the sliding seat, the effect of which is to limit the active work of certain muscles, and thus take from the exercise a portion of its value. The "shells" and "gigs," light, frail structures, which figure so prominently in regattas and races, ought to be left to those who row for display or reward. For one who desires to enjoy with safety and profit this elegant sport, the proper outfit is a staunch boat of graceful outline, and broad enough to bear a twist of the body without overturning. The danger from upsetting is about the only legitimate objection that can be urged against rowing, and to increase this liability for the sake of securing lightness and speed is unjustifiable.

Some attention must be paid to clothing worn during the exercise. The perspiration flows freely, and, if the rower rests too long, dangerous chilling of the body may occur from too rapid evaporation. Woollen clothing will be found the most suitable on all occasions. The practice of rowing in a half-nude condition is unnecessary, and will be indulged in only by those who make rowing a trade, or by the fops who desire to imitate them.

Swimming brings in action a large number of muscles. It cannot. however, be regarded as of much use as an exercise, on account of the various circumstances interfering with its practice. Harm is often done by remaining too long in the water. The best authorities are in favor of very short periods, twenty minutes being about the extreme, ten or fifteen minutes being a more suitable time. As soon as the swimmer leaves the water the body should be dried thoroughly and the clothing assumed as rapidly as possible.

Surf-bathing, now so popular, is beneficial to other organs besides the muscles. It has, however, been pointed out by surgeons that a number of cases of serious injury to the ear, resulting even in deafness, have occurred in consequence of the waves striking forcibly on the side of the head. A recent writer, who has had much experience in matters of this kind, has advised the use of a light cotton plug in the ear.

Persons who visit the seaside at rare intervals and for short

periods, often, for obvious reasons, overdo the matter of surf-bathing, and remain in the water until the skin is thoroughly chilled. From this various troubles result, such as catarrhs, all kinds of which prevail among seaside bathers. Many people think it impossible to take cold after coming from the surf, and ladies especially will sit about for a long time in order to dry their hair. This practice is injurious and should be avoided.

As regards the time of day for bathing, whether in salt or fresh water, it should not be just after a meal or when very much fatigued. Very early morning does not seem objectionable, and many persons prefer this hour. About the middle of the afternoon is also a suitable time [unless the dinner-hour is at mid-day, when eleven o'clock is usually chosen as the best time, without reference to the state of the tide.

It is a matter of observation that for several days after sea-bathing is commenced, nearly all persons suffer from slight loss of flesh and more or less languor; they usually recover from both quite rapidly, and are much invigorated by subsequent baths. After another period, varying from two to three weeks, however, both of these symptoms are likely to recur, when further bathing should cease, as it is apt to lead to harm rather than benefit. Persons who are not robust had better bathe on alternate days rather than every day; and those who are still more feeble may well make use of a simple sponge-bath, with sea-water which has been exposed in an open bucket for several hours to the open air.

Much of the benefit derived from residence at the seaside comes from the bracing air—possibly in some degree from the ozone which it contains—rather than from bathing in the surf.—Ed.]

Sparring is an exercise which is too much neglected. It has been largely consigned to the company of pugilists and professional athletes. It is, in reality, a most effective and valuable method of developing the muscular system, especially of the upper part of the body and loins. The blow that is given in scientific boxing is produced in part by the quick rotation of the chest on the hip, and sets of muscles are affected in this way that barely get into action under other forms of exercise. If one does not care to spar in the regular way, the sand-bag practice is an excellent substitute. A stout bag capable of holding several bucketfuls, is filled with sand and suspended so as to swing freely. It may then be punched or struck a rapid succession of blows, after the manner of boxing. As it opposes a resistance to the arm, the exercise is much better than the simple movement of the limbs about in the air.

We have numerous other forms of exercise, the qualifications of which are more or less similar to the typical forms which have been discussed. Among these we may enumerate, for instance, *fencing, quoits, lawn tennis, ball-playing, billiards*, and *shuttle-cock*. Some of these are pastimes rather than exercises. Others, such as billiards and quoits, are rather methods of training the muscles to delicate movements than means of developing their strength. All of those which, like billiards, are to be carried on in-doors, may be open to the serious objection of the want of fresh air and change of scene. Of some of these games it may be said that, while in themselves too light and easy to be of much value to the muscular system, they form, sometimes, the only means of keeping young people of over-studious habits out of doors, and thus fulfil an excellent purpose.

Of winter sports it has already been said that the opportunities are uncertain. Few things, however, are more invigorating and healthful than suitable and active exercise on a cold day. Hence, when the chance occurs, sledding, skating, sliding — and even snow-balling—may be indulged in with benefit. Sleigh-riding, when attended with the custom of frequent stimulation by hot whiskies, etc., can hardly be reckoned as a beneficial winter sport.

Time for Exercise.—As regards the time of day to be selected for any exercise, it is not possible to lay down any rules, since considerations of convenience, opportunity, season, and temperature will be mainly influential. Mid-day in winter, and early morning and evening in summer, are in general preferred for obvious reasons. For those predisposed to malarial fevers, the evenings during spring and autumn are somewhat dangerous, especially in the neighborhood of woodlands and slow streams. Nevertheless, the prevailing dread of night air is somewhat unreasonable. Very often it would be better for persons to be in the fresh out-door air of night, even if it were damp and cool, than to be breathing the impure air of our living-rooms. If, at night, we feel cold and uncomfortable, it is by no means always an indication that we should go in-doors, but may be a simple reminder that we need warmer clothing.

Exercise—that is, *active* exercise—should not be taken very close to the hour for meals. If indulged in immediately before a meal, the system may be in a condition too depressed to furnish the digestive secretions. On the other hand, if the muscles be exercised while the stomach is full of food, the nervous stimulation necessary to digestion may be drawn away, and the work of the stomach will cease. Midway between the hours for taking food is therefore the best time in most cases. In exceptional cases, as

where the strength fails rapidly during the interval, the exercising may be within about an hour after taking food.

It has already been stated that no form of exercise should be carried to such a degree as to cause fatigue or exhaustion. This is a point of great importance. One must, however, distinguish clearly between true fatigue and the feeling of languor or indolence which results from temperature or some other atmospheric condition. In the spring of the year, at least in this climate, we are liable to a feeling of lassitude which is popularly known as "spring fever." This is, in part, a real depression of the system; a sort of reaction from the long strain which the severe and variable weather of the winter has caused. In this condition we have deficiency of our strength and a lowered nervous tone, and for its relief we require tonics, rest, and nourishment. The trouble, however, is not always as serious as this. It is certainly, very often, a mere condition of inaction, and its best relief is exercise. If we yield to the languid feeling it will increase, and a common result is that we fall into a sleep, perhaps in an uncomfortable position, and awake to find our clothes and skin bathed in perspiration, some pain in the head, and the appetite impaired. The proper remedy for the original languor is brisk muscular action. A rapid walk or some active manual labor will soon dispel the disagreeable feeling.

Exercise for Invalids.

All that has as yet been said in this essay has related to the exercises of those in moderately good health, or at least not actively diseased. It will be proper to devote a few lines to the subject of the exercise for invalids. This problem is a difficult one. As a rule the strength is very defective, and in a certain class of cases the will of the individual cannot bring the muscles into action at all. It is, therefore, necessary, in order to prevent the muscular system from wasting, to depute to some second person the duty of acting upon or manipulating the diseased muscle or limb. Several standard methods are now in use. Two of the most important are *massage* and the so-called *Swedish movements.*

Massage is a system of kneading or mechanical irritation. The diseased parts, such as a paralyzed muscle, are gently stroked or vigorously rubbed; they are kneaded by deep grasps, or briskly tapped or struck with the finger-ends. The process may be extended to all the accessible parts of the body. The immediate result of the operation of massage is a quickening of circulation, increase of temperature, and direct and reflex stimulation of ner-

vous and muscular action. The process is useful in chronic diseases and injuries of the joints, in sprains, in dyspepsia, in diseases of the skin, and in nervous affections.

The **Swedish movement** system, if carried out by one who understands it, is more effective than *massage* used alone. Without entering into any lengthy description of the system, we may mention a few of the typical forms of movement. These are active and passive, single or duplicated. *Active* movements are those more or less under control of the individual under treatment. *Passive* movements are performed independently of the will of the patient. He is subjected to pushings and pullings, to swingings and rotations which he neither helps nor hinders. *Single* movements are, of course, active, since the patient performs them himself. *Duplicated* movements are performed by the aid of an assisting person. They are *active* when the patient is enjoined to resist the effort to move his muscles ; they are *passive* when no resistance is made. Passive movements are somewhat like massage. To give any extended account of the methods of performing these movements, and of the cases in which they are applicable, would be to leave the proper field of this essay, but the following description is an account of a duplicated active movement performed in the regular way. Suppose it is desired to bring in action the muscles concerned in flexing the forearm. The arm being extended, with the palm of the hand upward, the manipulator takes hold about the wrist, and directs the patient to draw the hand toward the shoulder. As the latter performs the movement the operator carefully resists, allowing, however, the hand gradually to reach the shoulder, where the patient tries to keep it, while the operator slowly brings the arm into its extended position.*

Mental Exercise.—It has been remarked at the beginning of this essay that no form of exercise is quite satisfactory unless it calls the mind as well as the body into activity. These two portions of our nature are intimately connected, and react upon one another, yet it is rare that we find them in equal development in any one individual. While it may be accepted as a truth, or at least as a safe maxim, that a sound mind belongs to a sound body, we have many instances in which high intellectuality has been associated with feeble bodily health, and *vice versa*. Descartes, the founder of a great system of philosophy, was not expected to reach adult age, and remained always in feeble health ; William of Orange, whose active and shrewd mind controlled for a time the destinies of Western Europe, is called by Macaulay "an asthmatic

---

* See, also, chapter on Therapeutics : or, The Modes of Employing Remedies.

skeleton." On the other hand, no one would seek for mental attainments among the athletes and brawny laborers who present such fine specimens of bodily development. Whence arises this contrast? It would be a fatal error to reason from it that the cultivation of mental and bodily health are antagonistic influences. They may and ought to be carried on together. Space does not permit of an extended discussion of the many ways of cultivating and strengthening the mind; but it is certain that even the highest of its faculties, such as our moral nature, may be modified by use or neglect.

The refinements of civilization do not interfere with the actions of the mind as with those of the body. The brain diseases met with in our large cities are most frequently those of over-action or exhaustion. What is needed in this field is direction and control rather than the suggestion of new methods. In fact, the whole subject of education might be here entered upon, for it is in large part merely a system of mental training. The youthful student pours over Greek and Latin, not so much that he may know these languages as that by a series of processes the faculties of memory and comparison may be strengthened; the mathematical branches develop the powers of reasoning and of abstract thinking, and so with the other subjects. Volumes have been written upon the methods of education, and the subject is not yet disposed of. The best writers are, however, of the opinion that in most educational institutions the hours of study are too long, and we know very well that the hygienic surroundings are often very unsuitable, the light being badly arranged, the rooms unventilated, and the books printed in type too small for comfortable reading.

It is scarcely necessary to speak of the harm done to the mind by the "romantic literature" of the present day. This is rolled out upon the community by the ton, and inflames and distorts the emotions and judgment of the young of both sexes. Doubtless it will some day be made the subject of legal supervision.

Among the minor habits which prevent satisfactory mental development is that of careless reading. Many persons, instead of reading a work closely and with an endeavor to understand each sentence, skip from line to line in a hurried way, and thus acquire but a superficial notion of the subject-matter. This is a habit which rapidly grows, and, unless corrected, will bring the person into a condition in which it will be impossible to follow carefully any explanation or demonstration. As a corrective the practice of reading aloud in the presence of some other person is very useful.

JOHN V. SHOEMAKER, M.D.

Hygiene—House Building.

BY

CARL PFEIFFER, Architect,

OF NEW YORK CITY,

CONSULTING ARCHITECT TO THE HEALTH DEPARTMENT OF THE CITY OF NEW YORK; FELLOW
OF THE AMERICAN INSTITUTE OF ARCHITECTS,
ETC., ETC.

HYGIENE—HOUSE BUILDING.

THE dwellings of a people and their home-life should not only furnish indications of the state of intellectual and moral advancement of the community, but it is also a matter of the utmost importance that these homes should be constructed in accordance with the conditions which are requisite for the physical health and comfort of their occupants. To show how this may be attained, I will mention the following essential points which should guide those who undertake the construction of a house :

1st. A healthy site, affording an aspect which gives light and cheerfulness.

2d. Thorough drainage, which will insure dryness of the site of foundation and walls, and of the cellar.

3d. Efficient sewerage, which shall render it impossible that the air shall be contaminated from excreta and matters which may undergo decomposition.

4th. Purity of atmosphere—abundant ventilation.

5th. A proper system of heating.

6th. Abundance of sunlight for every room of the house, particularly for the sleeping apartments of children.

7th. A supply of pure water.

8th. Facility for maintaining the most scrupulous cleanliness.

9th. Employment of none but the best and most conscientious mechanics.

Healthfulness of Site.

When it is determined to erect a dwelling-house, the first consideration should be, the choice of situation as respects its dryness and general healthfulness. Lord Bacon has said, " he who builds a fair house upon an ill seat, committeth himself to prison."

The soil on which the house rests, and all circumstances connected with any local geological peculiarity or variety of climate, should be taken into consideration.

Soil is known to affect health: "*a*, By its conformation and elevation; *b*, by the vegetation covering it; *c*, by its mechanical structure, which influences absorption and radiation of heat; reflection of light; absorption and retention of water; movement of water over and through the soil; passage of air through the soil; formation of dust; *d*, by its chemical structure, which acts especially by altering the composition of the air over the soil, or the water running through it." *

Among hills, the unhealthy spots are enclosed valleys where the air must stagnate: such situations as ravines, or places at the head or entrance of ravines. In valleys where the prevailing winds sweep across the top of the rising ground on either side, buildings below are often subject to excessive heat and moisture. The neighborhood of marshes and of manufactories discharging deleterious gases and vapors should be avoided.

The effect of vegetation on ground is very important. In cold climates the sun's rays are obstructed, and evaporation from the ground is slow; the ground is therefore cold and moist, and the removal of wood renders the climate milder and dryer. In hot countries vegetation shades the ground and makes it cooler. The evaporation from the surface is lessened, but the evaporation from the vegetation is so great as to produce a lowering effect upon the temperature of a place.

Dense vegetation, thick clusters of trees in the immediate vicinity of a house should be avoided, as the movement of air is impeded and sunlight obstructed; the air becomes stagnant and favors the spread of diseases, though a belt of trees at some distance from a house may afford a protective influence against malaria. While the presence of trees and bushes in the neighborhood may not sometimes be desirable, herbage is always healthy. It cools the ground, both by obstructing the sun's rays and by aiding evaporation.

Nothing is more desirable than to cover a sandy site with close-cut grass so as to prevent the reflection of light and the effect of glare on the eyes. Sand absorbs and has greater power of retaining heat, and is, therefore, warmer than other soils.

Clayey soils are cold, and as they are also damp, they favor the production of rheumatism and catarrhs which no underdrainage can effectually overcome.

Wet clay and rock absorb and retain water more than other soils, and should be avoided. Dryness of site is essential to the salubrity of a house; moisture aids in the decomposition of the or-

---

* Parkes' Manual of Hygiene.

ganic matter of the soils and favors the development of malaria and consumption. If possible, never take ground which has been much disturbed, and always avoid sites of old dwellings. Soils which are naturally porous, from which rain rapidly disappears, are known to be the healthiest situations for the sites of houses. As a rule, then, the dry soils, sand and gravel, are the healthiest.

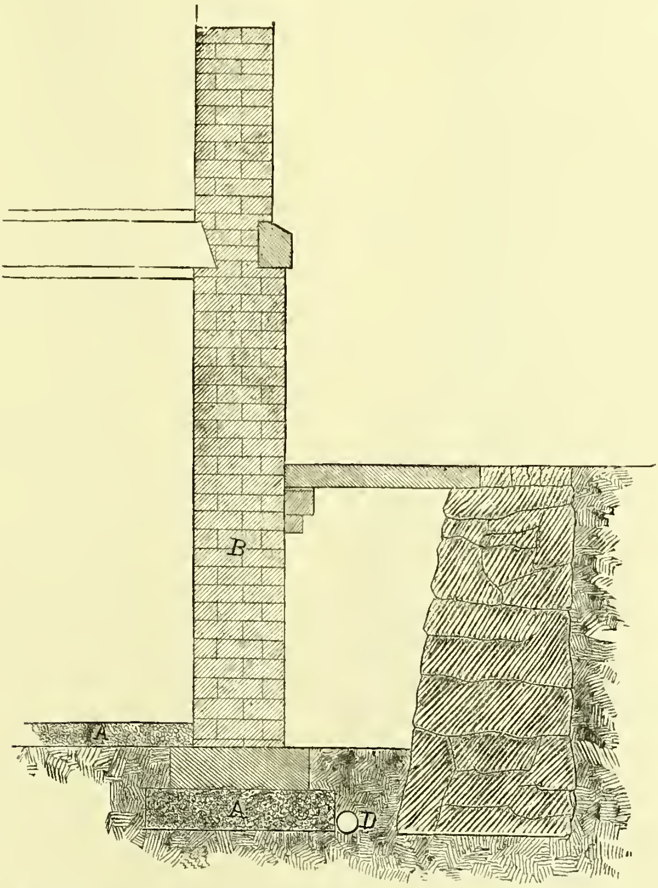


FIGURE 159.—The letter A indicates concrete; B, the wall of the building; C, the independent wall, and D, the drain-pipe at the bottom of the foundation.

Coarse gravel is also the safest soil to build upon, as it is almost incompressible and makes a firm foundation.

As the modes to be adopted to secure dryness of site are mentioned in the chapter on Drainage, Sewerage, and Water-supply, page 167, and illustrated in Fig. 125, they will be here referred to only so far as relates to insuring dry foundation walls.

Damp walls and damp cellars may also be prevented by having an area or air-space all around the walls below the surface of the ground; where desirable, the area may be covered with flagstone slabs, as is shown in Fig. 159. The same purpose may also be accomplished by an outside lining or an independent wall on the outside of the cellar-wall, leaving an air-space of four inches between it and the cellar-wall proper. See Fig. 160. The air-space and the independent wall to be covered with stone slabs. The thickness of the independent wall need not exceed the width of a brick, if well bonded to the main wall, taking the precaution to have the bonding brick and the underside of the stone slabs well covered with asphalt, to prevent the communication of dampness. The outside of the independent wall, or any wall in contact with the ground, should have a thick coat of cement, and a thick layer of cement should be put upon the wall horizontally immediately above the level of the ground. The entire surface of the cellar-floor should have a layer of concrete not less than six inches thick, the top of the concrete to be finished with Portland cement, *hand floated* to a smooth, even, and perfectly hard surface. Where the sub-stratum of the cellar-floor is of rock or clay, it is best to put down, first, a layer of concrete four inches thick; upon this put tarred paper and asphalt, and again a layer of tarred paper and another layer of concrete four inches thick. The inside of the cellar-wall, from the foundation to one foot above the level of the cellar-floor, should be lined with asphalted brick. Even on a rock bed the foundation should rest upon concrete, the latter prevent-

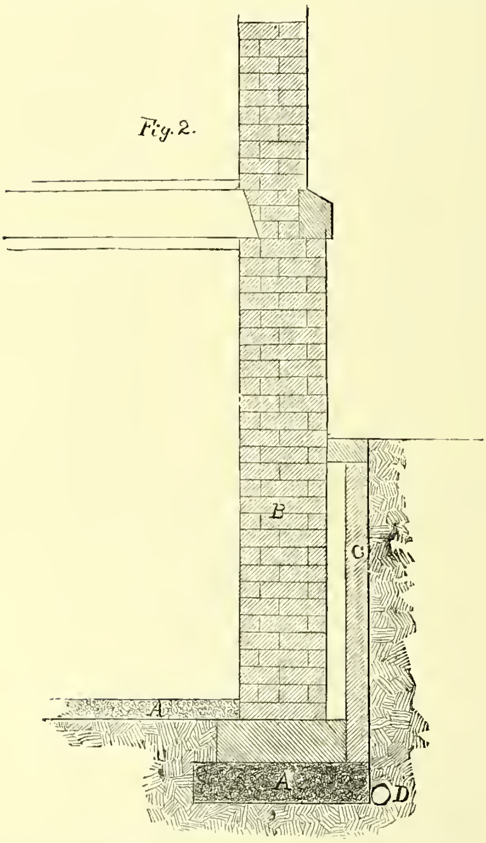


FIGURE 160.—A, A, concrete; B, the wall of the building; C, the independent wall; D, drain-pipe at the bottom of the foundation.

ing the rise of dampness within the wall. The most important precaution, however, is to lay a drain all around the outside of the cellar-wall at the bottom of the foundation, and extend the same to a natural outlet. For the largest private house, the smallest sized agricultural drain-pipes will be sufficient. *Under no circumstances should these pipes be connected with the sewer-pipes or cesspool,* and such works should, when possible, be executed under the directions of a competent agricultural or sanitary engineer; whatever the pretensions of the masons or the plumbers may be as to their ability in this connection.

Ventilation and Heating.

The object of ventilation is to maintain a pure atmosphere. To accomplish this it is necessary to furnish fresh, pure air to the rooms and expel the vitiated air.

In the provisions for ventilation, the first and main point to consider is a sufficient supply of fresh pure air ; where this is assured, little heed need be taken as to the *mode* of getting rid of the foul air. The supply should be so abundant and constant, that at no time and in no part of the room can any foul air be found, at least the degree of vitiation should not exceed the prescribed limit at which the air becomes unhealthy. A person entering a house should perceive no difference between the air of the room and the outside air in point of freshness and purity.

When it is decided to build a house, the matter of ventilation and heating should be made, at the start, an essential part of the arrangements of the plan. This will not only insure a more successful result, but will also accomplish the desired end with the least expense: In providing for the ventilation of a house it should be observed,

1st. That each room should have one or more flues for the escape of foul air, proportioned to the number of occupants as follows :

A room	usually occupied by	one	person	should have	a flue of	6 by 6	inches.
"	"	two	"	"	"	8 × 8	"
"	"	four	"	"	"	8 × 12	"
"	"	six	"	"	"	12 × 12	"
					or two flues	8 × 9	"
"	"	eight	"	"	" "	8 × 12	"
"	"	twelve	"	"	" "	12 × 12	"

or several smaller flues of the same capacity collectively.

2d. In the evening, when the lights are burning, additional capacity for ventilation becomes desirable. Where chandeliers are

used, a flue for carrying off the combustion of the gas should be in the ceiling immediately over the chandelier. The plaster "centre pieces" usually placed over the chandeliers in the ceiling should be perforated and connected with such ventilating flues. Due allowance should also be made in a room where there is to be much tobacco-smoking, and enlarged capacities for ventilation should be provided in cases of entertainments.

3d. Inlet flues for fresh air should be provided equal in size to those provided for the escape of foul air.

4th. The fresh air should be moderately warmed before it is introduced into apartments during cold weather. Pains should be taken to avoid cold draughts and currents. A very simple mode of warming the air is to have a fireplace with an iron hollow back and sides; the hollow spaces forming air-chambers into which fresh air is admitted from the outside and becomes warm before it passes into the room. The outlets may be made at the sides of the mantel or in the chimney breast near the ceiling. The so-called "Baltimore stove" or fireplace heater can be used for the same purpose. The floor near the stove could be perforated and fresh air supplied by using the space between two beams as an air-duct. In this way much can be contributed to the ventilation and healthiness of an apartment.

5th. Where it is necessary to introduce cold, unwarmed air, measures should be adopted for breaking the first and harsh impulse of a cold raw atmosphere, by causing it to enter with a gentle diffusion. It should be introduced at *the ceiling* where it would necessarily spread over a large space before it comes in contact with the occupants.

6th. The halls and passages should be made reservoirs of fresh air for the supply of air to rooms, so as to give a milder atmosphere within the house, when there is severe heat or cold externally.

7th. The halls and passages should be heated by stoves or otherwise during cold weather, in order to avoid cold draughts.

8th. All flues for the admission or exit of air should be provided with valves so as to be under control according to the requirements of the number of occupants.

9th. It should be borne in mind that any system of ventilation requires constant and intelligent attention, and should not be left to the care of ignorant attendants or servants.

10th. All doors communicating with halls, stairs, or passages, should have movable fanlights or hinged panels for purposes of ventilation.

11th. An ordinary fireplace may be considered sufficient for ventilation of a room occupied by six or eight persons, when there

is a fire in it; pains should be taken, however, to supply the proper amount of fresh air.

12th. Ventilating flues should be within inside walls, or in chimneys where they will be warmed by surrounding smoke-flues. When chimneys are placed back to back between two adjoining rooms, a ready means is afforded for a large ventilating shaft as is shown in Fig. 161. The shaft will be heated by the backs of the

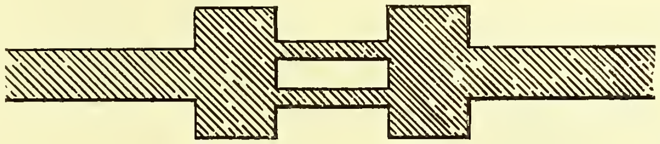


FIGURE 161.—Arrangement of a ventilating flue between the backs of two smoke-flues.

fireplaces, which will promote a ventilating current. An additional means of facilitating the flow of air can be provided by placing a smoke-pipe from a heated stove or furnace within this shaft.

The same principle can be adopted by providing a large foul-air shaft in some other way, between closets or at any convenient place, and heating the same by smoke-pipes, steam, or hot-water pipes, or by gas-lights when these are more attainable. Where no mechanical means are employed, the movement of air in flues is produced by a difference of temperature in the air in the interior of the house as compared with that of the air outside. When the house is warm and the outside air is cold, active currents will take place which can be maintained as long as the outside temperature is at least thirty degrees less than that inside of the house. Inasmuch as these conditions exist during the cold seasons only, it becomes necessary to heat the foul-air flues at other times of the year.

When a ventilating flue or shaft communicates directly with the open air, it often happens that a downward current takes place; in order to guard against this, the top of the flue or shaft should be capped with a ventilating-cowl. There are a great variety in the market. We believe the one known as the "Emerson Ventilator" to be the best; it is shown in Fig. 162. We know from experience that it facilitates an upward and prevents a downward current. Where a flue or shaft extends above the roof, similar to a chimney, another plan will be found to be effective, and should also be adopted for all chimneys to prevent a downward current. The top should be entirely covered and openings left on *two*

sides of the shaft ; in a stack of several flues, the partitions should be carried up to the covering-plate or capping-stone. (See Fig. 163.) Pains should be taken that the perpendicular height of the opening does not exceed two-thirds the diameter of the flue, and the cover should be twice the diameter or width of the flue.

According to the rules of good construction, each flue should be carried up and out to the open air as straight and direct as possi-

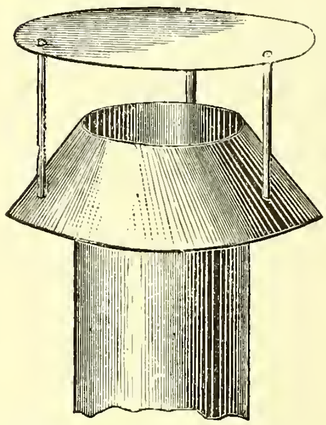


FIGURE 162.—Emerson's ventilator.

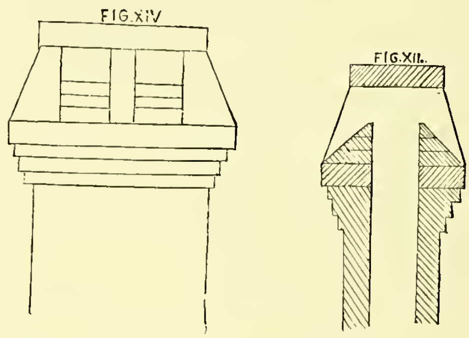


FIGURE 163.—Front and sectional view of a chimney constructed so as to avoid downward drafts.

ble without communicating with any other flue. This, however, is not always practicable, and a successful system of ventilation has been adopted of providing a foul-air chamber in the attic into which all the ventilating flues terminate, whence the foul air is removed by two shafts, one taking the foul air from the chamber downward and discharging it at the level of the lowest floor into an upward shaft. The upward shaft is heated by an iron smoke-pipe from the kitchen or furnace fire, by gas lights, by steam- or hot-water pipes, or by a grate or stove at its base. In this way greater suction power is gained than if a shaft were to open from the air-chamber directly out of the roof ; a more uniform suction on all the ventilating flues is also secured, and the danger of counter-currents in the flues is better guarded against. The next figure illustrates the arrangement. The shafts for the discharge of the foul air should be equal to the combined capacity of all the flues.

In order to make use of the fireplace as a ventilating shaft when there is no fire in it, particularly in bed-rooms, a gas-burner may be put into the smoke-flue to induce a current by its heat. The

gas-burner can be made accessible by cutting an opening in the chimney-breast above the mantel, and the opening may be covered by a hinged picture, answering as a door to the opening. Instead of an ordinary painted picture, it may be stained glass, or a glass or porcelain transparent picture. The latter was used in a house in New York City and met with great favor. When lit upon going to bed, the ladies found it a source of comfort and compan-

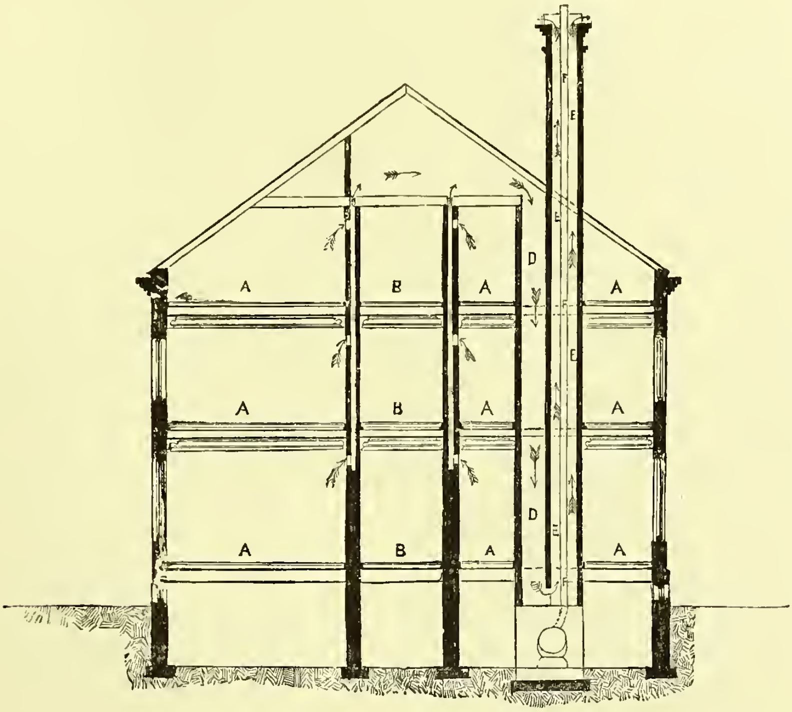


FIGURE 164.—Arrangement for equalizing the ventilation of a house: A, chambers; B, halls; D, downward current to furnace or stove-room; E, upward current to outer air; F, smoke-pipe passing through centre of ventilator-shaft.

ionship; it was also a source of amusement to guests who did not know the cause of the illumination of the picture.

Fireplaces are most efficient ventilators; pains should be taken to provide one for every room, and more particularly for every bed-room. A convenient way to supply fresh air to a bed-room, if it is desired to keep the window closed, is, to have a flue in the wall which opens above the roof, and has an induction cowl on its top to facilitate a downward current. The flue should be close to the spot where the bed is to stand, and open into the room near

the floor, so that the air will diffuse itself under the bed before it rises. The opening of the flue could be immediately behind the skirting or base-board, a piece of which should be hinged to form the flue-door for admitting or excluding the air, as may be desired.

It would be of advantage if every bed-room could have a little closet into which to place the chamber-pot, which closet should have a separate ventilating-flue. This closet could be formed by a simple recess in the wall near the floor, with a piece of the base-board hinged to form a door.

Fig. 165 illustrates how the ordinary hot-air pipe which supplies heat to a room may be utilized to assist in ventilation. B represents a tin pipe conveying hot air to the second story. It warms sufficiently the ventilating flue A to rarify the air and induce a

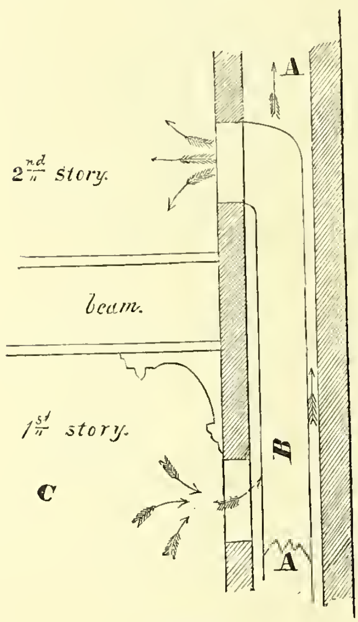


FIG. 165.

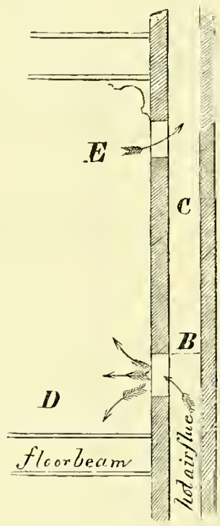


FIGURE 166.—A, hot-air flue; B, sheet-iron cover to the same; C, the ventilating flue; D, hot-air discharge, and E, the ventilating register.

current into the flue at the foul-air register C near the ceiling of the first story.

Fig. 167 shows the same principle differently applied. The apparatus is placed in a flue near the floor of the room to be heated and ventilated.

The flue, it will be observed, is supplied with a partition at some

little distance below the register opening, through which the heat from the furnace below is to be delivered.

Upon this partition, and communicating directly with the heated-air column, is placed a sheet-metal pipe, which terminates in the upper half of the register. Through this the heated air is poured into the room. The lower half of the register is designed for ventilation; the design being thus to take advantage of the circulation which would be naturally established, and to draw off the somewhat cooled and vitiated air from below.

In the upper part of the hot-air pipe there is an adjustable valve, which can be operated by means of a handle projecting on the outside of the register-plate of the hot-air opening, whereby either a portion or the whole of the hot air rising in the hot-air pipe can be discharged at any time into the vitiated air-flue (the register of the hot-air pipe being either opened or closed accordingly) and thus increase the warmth and consequently the draft of the vitiated air-flue — a result of great importance in crowded rooms when the heat becomes excessive and the air very impure.

A simple experiment with an ordinary register, especially if it be large, will show the greater bulk of the heated air which it emits is thrown out from its upper part, while a considerable in-draft from the room is constantly entering its lower part. It was this observation which led to the construction above described. A candle or handkerchief held before the two halves of the combined device indicates clearly the direction of the ingress and egress currents.

An effective ventilating flue can be made by continuing the flue used for hot air above the opening where the hot air is discharged; at the upper level of the hot-air opening, cover the hot-air flue with sheet-iron or tin, punch a quarter-inch hole into the cover so as to admit some heated air into the ventilating-flue. See Fig. 166.

A small branch pipe, three-quarters by two or three inches, may be attached to a hot-air pipe and carried on the face of a wall that is furred, or it may be sunk into the wall and carried to a ventilating-flue, discharging hot air into it to facilitate ventilation, and it may, at the same time, serve as a safety-valve when it is necessary to shut off the heat from the room; when, if the heat were to be confined in the flue, it might set the building on fire, all of which would be prevented by the branch pipe forming an outlet for the heated air. This arrangement is shown in Fig. 168, which represents a wall of a room.

In connection with the supply of fresh air, great care should be

taken to secure it from a pure source; the vicinity of stables and other impure localities should be avoided. Where a furnace is used to heat a house, it is usual to have an air-box which receives its supply of air quite near the ground, and as a consequence a great deal of dust and organic impurities are blown into the house. In city houses an air-shaft should be built at the rear of the house, terminating above the roof with a revolving cowl, the mouth of which must always be towards the current of the wind; this air-shaft should be connected with the furnace, thus insuring a permanent and pure supply of air. Where there is an open ground around a house, a shaft ten or twelve feet high may be built at a short distance from the house, and by an under-

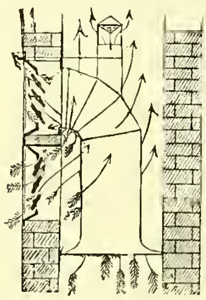


Fig. 167.

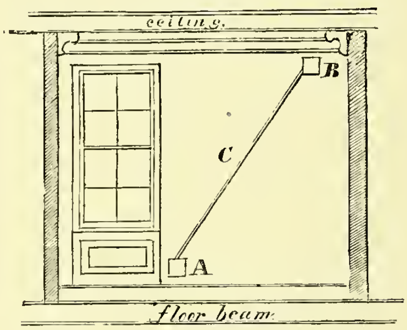


Figure 168.—A, the hot-air register; B, the ventilating-register: C, the branch-pipe. The latter should be extended two or three feet upward into the ventilating-flue.

ground duct, or large earthen pipes, may be connected with the furnace, but the shaft should have an inducting cowl as just mentioned.

In concluding the matter of ventilation it may be well to refer to the question so often asked: where shall the foul-air exits be placed—at the floor or at the ceiling? I have carefully investigated the subject, and find an overwhelming majority of authorities in favor of having them on or near the ceiling. My own experience in the construction of many public and private buildings has confirmed this view. The argument that because carbonic acid gas is heavier than air it would fall to the floor, has been found erroneous. The constituents of air do not stratify themselves according to their specific gravities, but are diffused to an unlimited extent. One of the most prominent scientific men, an authority on ventilation, referred to an advocate of floor-ventilation, saying: "It was pardonable at that time because the law of the diffusion of gases was

not known." The discovery of this law has done much to establish the true principles of ventilation. Æriform bodies possess the property of diffusing themselves through each other's masses to an unlimited extent; there is no point at which they become saturated.

It has been shown that carbonic acid is so generally diffused in the air that it does not separate from it, that it does not fall to the floor, and the advocates of floor ventilation are not supported in their assertions by scientific demonstration. It needs no scientific experiments to convince an observer that the fresh air which comes into the rooms by the crevices of the doors and windows tends towards the floor and will rise towards the ceiling as it becomes warm. One can breathe more freely near the floor than near the ceiling.

The principal reason, however, for placing the foul-air exits at the ceiling, is the demand of the laws of health that the breath expelled from our lungs should not be inhaled again, but should be at once removed and replaced by pure fresh air. Our breath is about the same temperature as the body, or 98 degrees; and as the temperature of our rooms is rarely more than 70, the breath is pushed upward toward the ceiling, and should be pushed out of the room at the ceiling, which will be done if there is sufficient fresh air admitted to take its place.

The so-called "practical man,"—the man who is too ignorant to have any theories—will advocate floor-ventilation for reasons of economizing heat. Suffice it to say that I know this to be erroneous, and have found no inconvenience or difficulty in heating large wards of hospitals by introducing the hot air ten feet above the floor, and ventilating at the ceiling, the hot-air openings being placed at that height to prevent patients from sitting near them.

Good ventilation necessarily demands increased consumption of fuel, but it will also save doctor's bills, and insure a longer, healthier, and a happier life.

The most healthy modes of heating a house are those in which fresh air is passed over *moderately* heated surfaces and conducted to the apartments to be warmed. In this way a constant change of air takes place, and a more general diffusion of warmth. Heating by an ordinary close stove is the most objectionable, but its injurious effects can be mitigated if a supply of air be introduced immediately under the stove, which can readily be done by means of a pipe under the floor, or by using the space between two beams as an air-duct. Wrought-iron stoves constructed with air-chambers into which fresh air is conducted and warmed, sim-

ilar to the kind known in the trade as "Fire on the Hearth" (see Fig. 169), are to be preferred to an ordinary close stove.

Heating by a "fireplace" or open grate fire is to be commended as a good method, but it is the most wasteful of fuel; it has been well proven that seven-eighths of its heat is lost in the chimney. Much of this lost heat can be saved by having fireplaces with hollow backs, into which air is introduced and heated, and conveyed into the room.

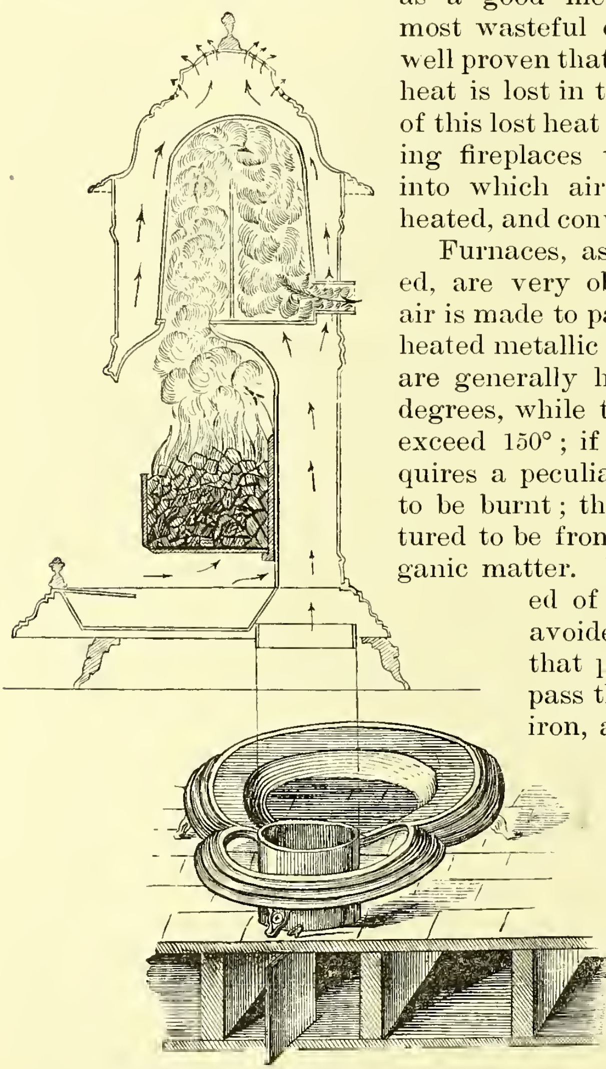


FIGURE 169.—"Fire on the Hearth" stove.

Furnaces, as usually constructed, are very objectionable, as the air is made to pass over excessively heated metallic surfaces. Furnaces are generally heated to 400 or 500 degrees, while the heat should not exceed 150°; if it does, the air acquires a peculiar smell, and is said to be burnt; this had been conjectured to be from the charring of organic matter. Furnaces constructed of cast-iron should be avoided; it has been shown that poisonous coal-gases pass through red-hot cast-iron, and are mixed with the furnace air. [See page 155.] Wrought-iron is to be preferred to cast-iron, and soap-stone is superior to both, if so constructed that no coal-gases can pass through the joints of the stone. Soap-stone furnaces are being considerably used in the New England States.

Furnace-heated air would be less objectionable and quite harmless if two or three furnaces were used where one is ordinarily deemed sufficient, in which case a corresponding increase should be made in the cold-air supply. A large body of air, gently

heated, should be preferred to a smaller body heated to a greater extent; the hot-air outlets in rooms should be more numerous, to insure a more uniform diffusion of heat.

Air heated by steam or hot-water pipes is preferable to furnace-heated air. A great convenience in a steam apparatus is the facility with which the pipes can be conveyed in any direction, and its application to various purposes, especially in large public buildings. Its disadvantages are the absolute necessity which exists for constant attendance and watchfulness; its want of permanence of temperature, and its increased cost of fuel above that of a hot-water apparatus. One of the greatest advantages which the plan of heating by hot water possesses over all other inventions for distributing artificial heat is, that a greater permanence of temperature can be obtained by it than by any other method.

The difference between an apparatus heated by hot water and one where steam is made the medium of communicating heat, is not less remarkable in this particular than in its superior economy of fuel. Another advantage of a hot-water apparatus is that it requires no skilled attendance, and can be managed by a servant of ordinary intelligence. People complain sometimes of steam-heat or heat from hot-water pipes as being unpleasant. The fault is not in the apparatus but in the want of a supply of air, and the want of ventilation where this is not provided. The same objection holds good which has been made against the use of closed stoves. The best disposition of steam or hot-water pipes is to place them in the cellar enclosed in an air-chamber or box, and, passing the air over the pipes, conduct it to the rooms by flues. Coils of pipe may also be placed in the halls or passages, where there is apt to be much cold air from the opening of doors leading to the outside. If coils of pipe are placed in a room they should be put in below or in front of the windows to heat the cold current of air which comes in through the crevices.* Placing them under or in the recess of a window affords an opportunity to furnish a supply of air by various contrivances of which an intelligent mechanic will avail himself.

The most perfect mode of heating a house is to heat the floors and walls. Cold walls and cold floors cause condensation and cold drafts, particularly at the floor, where there is always a stratum of cold air from which people are liable to catch cold, and which would be avoided by having a warmed floor. This plan is neither

---

* [It is usually the downward current of air cooled by contact with the glass which gives the impression of a draft of wind blowing through the crevices of a window.—Ed.]

complicated nor expensive. By using the cellar for no other purpose than as an air-chamber, and by heating it with a "portable furnace," or a large stove such as is used ordinarily in railroad stations, the floor of the story above the cellar would be warmed, and, by means of perforations or openings in the floor, the warm air could ascend. The walls should be hollow; the warm air of the cellar should be allowed to find its way into the hollow space of the walls, and into the spaces between the ceilings and floors of the upper stories. A constant supply of fresh air to the furnace or stove is, of course, a necessity to the success of the plan. We have mentioned a furnace or stove in connection with the plan because it is the most simple, but by the use of steam or hot-water greater perfection can be attained.

The ordinary way of heating a house by a furnace could be immeasurably improved, and the objection to furnace heat reduced to a minimum, by using a rotary fan to force the cold air through the furnace, at the same time insuring thorough ventilation. By the use of a fan, the air could be forced through the furnace in such quantities and speed as to prevent its being overheated or burnt. In summer-time it could be made the means for cooling the house or any one particular room, by disconnecting all other rooms with the air-chamber in the cellar.

The use of a fan in a dwelling-house may at first appear to be complicated; this is not so. A space 6×6 feet in the cellar can be set apart as an air-chamber, in which to place a revolving fan of three feet diameter; the fan could be worked by a water-motor, gas-engine, or any of the simple engines which are used in working sewing-machines. By connecting the ordinary air-box of a furnace with the air-chamber, the air would be forced out at all the openings with which the furnace is connected. All these preparations have been made in a private house at Providence, R. I., although the fan has not yet been inserted.

In a room where there is a great surface of window-glass, the sashes should have double glazing or the windows should have double sashes; twenty-five per centum of heat is usually lost by condensation on the cold surface of the windows.

[*Cooling.*

As opposed to methods of *heating*, it is desirable that something should be said here in relation to methods of *cooling*, since in nearly every portion of this country it is more or less desirable to possess some means for keeping articles of food cold during hot weather, and for cooling beverages. Although a num-

ber of machines have been invented, by which ether or ammonia can be vaporized and thereby produce a freezing temperature, these apparatuses have been most serviceable in the artificial production of ice in tropical climates, in certain manufacturing processes, and in restaurants where masses of ice are formed in the interior of water-bottles used on the table.

In many hot countries a very simple method for cooling drinking-water has been employed for centuries. Water is put into a coarse unglazed earthen vessel, and set in a draught of air in the shade, its mouth being closed to keep out warm air. As the water oozes slowly through the pores of the vessel, it is evaporated by the

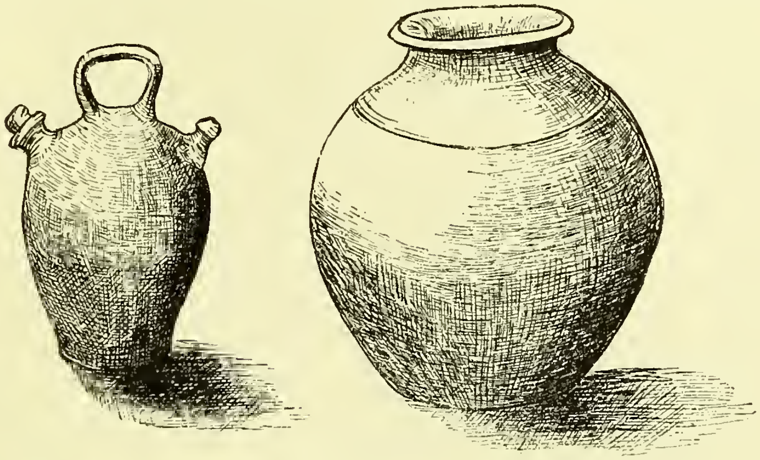


FIGURE 170.—Vessels of porous earthenware for cooling water by evaporation.

wind and cools the contents. The adjoining figures are made from such vessels now commonly used in Spain. The opening to the left of the smaller one is for filling the vessel, and the small spout on the right is to drink from. The handle serves either for carrying it or for the attachment of a cord by which to hang it in a veranda or to the limb of a tree.

Sailors sometimes cool their drinking-water by placing it in a clean bottle, corking it tight, putting it into a woollen stocking, which is then wet and hung in the rigging out of the sun. As fast as the water evaporates from the stocking it is renewed, and after a time the contents of the bottle will have become refreshingly cool. Soldiers' canteens are sometimes covered with a thick jacket of felt to serve a similar purpose.

The cellar usually found under most houses, fulfils, in some measure, the purpose of a cooling-room for articles of food; but when a furnace is placed in it to warm the house above, by the

radiation of heat the value of the cellar as a refrigerator, even in winter, is quite destroyed. It is necessary for the preservation of food that the air about it should be dry as well as cool, and free from organic matter ; but very many cellars are damp, the air in them contains effluvia from rotting fruit and vegetables, decomposing vermin, the urine and fæces of the family cat, rancid grease, the soap-barrel, decaying wood, spilled milk and cider, etc., etc., and it may be that the air of the cellar is further contaminated with ground-air from the neighborhood of an adjoining cesspool; while there is rarely any provision for the introduction of fresh air or the escape of that which is foul.

Another method sometimes resorted to for keeping small articles of food cool is to lower them by means of a cord into a deep well until they nearly reach the water.

In comparatively few instances do we find among farmers and the dwellers in villages any attempt to make use of ice or snow which has been stored during cold weather to be used when summer arrives, although the expense of securing and keeping such a supply is trifling compared with the benefit which results from having it. It is the want of a cold room which prevents many of the persons referred to from having fresh meat on their tables as often as their circumstances would otherwise permit ; and whoever has passed any time in a small country-village has had occasion to notice the tough and unsavory quality of the meats procured from the butcher's wagon at its periodical visit, as compared with the juicy roasts, steaks, and chops to be had of a city butcher. The secret of this is not so often in the quality of the meat as in

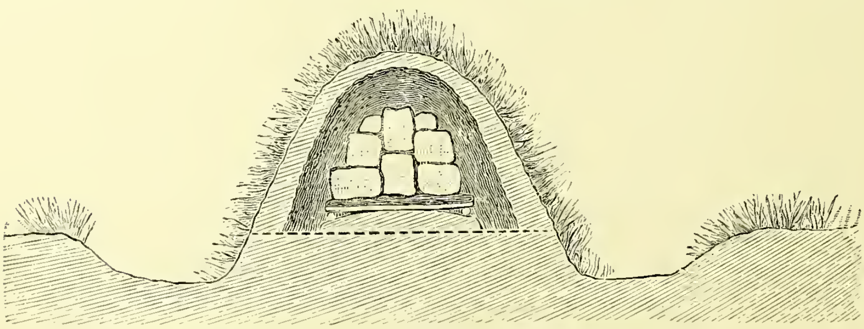


FIGURE 171.—Ice stored in a mound of straw and earth.

the fact that the country butcher sells his meat as soon as possible after it is slaughtered—usually on the following day ; while the city butcher, who has a regard for his reputation, will not sell his beef until it has been killed at least a week. To accomplish this

in warm weather he provides himself with an ice-room in which the temperature is so low that putrefaction does not take place.

There are many dishes and beverages suitable for warm weather for which a farmer's wife has the materials at hand, but which require a low temperature for their preparation. Perhaps there is no time when ice is so desirable as during the progress of some of the fevers to which rural districts are so liable, and the possession of a supply may then become almost invaluable.

Certain things are requisite in preserving ice during warm weather. It must be protected from air, and it must be kept dry. The simplest way to accomplish these is to raise a platform of earth above the level of the surrounding soil, being careful that it slopes from the centre to the edges. On this place a layer of sticks ; on the sticks arrange a bed of straw or saw-dust, and on this pile the ice closely. Cover the ice with more saw-dust or straw ; on this lay sticks, and over all make a bank of earth and sow it with grass,

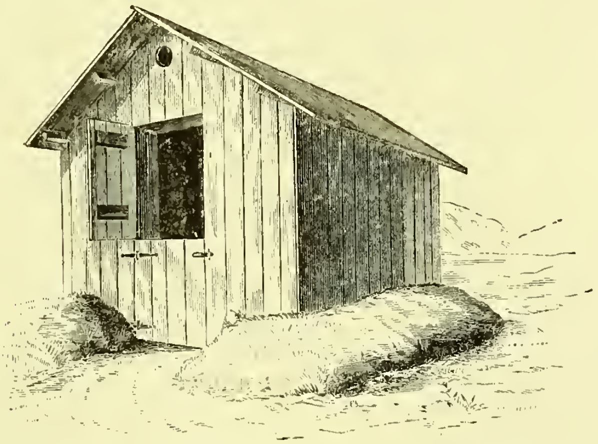


FIGURE 172.—A simple form of ice-house made of rough boards.

or cover it with hay or straw. A bank of this character may be made long and narrow, and opened from one end as fast as the ice is consumed. It is more customary in this country to build a house or shanty with hollow walls filled with saw-dust, planing-mill shavings, finely chopped straw, chaff, charcoal, or ashes. The fine coal which collects in enormous heaps about coal-mines is said to make an excellent filling.

In choosing a site for an ice-house, gravelly and sandy soils are the best and clay is the worst : a side hill by which a part of the room can be surrounded economizes lumber, furnishes earth for bank-

ing up the wall, and enables the wagon or sled on which the ice is hauled to the house to come nearly on a level with the upper part of the door, and thus saves labor in stowing. The floor of an ice-house should have a decided and even slope toward one corner, where a trapped drain-pipe may take to a distance the water which accumulates, or where a pit may be made large enough to hold a couple of wagon-loads of stones and form a drain.

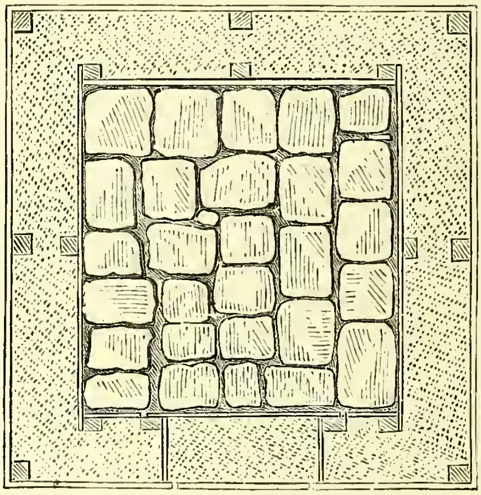


FIGURE 173.—Plan of ice-house.

It is best to have the door of access on the north side, and it is of great service to shelter the house from the sun by means of trees and creepers. The outside of the house should be whitened with lime-wash or paint. When a foot or a foot and a-half in thickness of sawdust, shavings, or finely chopped straw intervenes between the sides of the house and the ice, an inner sheathing of boards is not essential, but the filling will require to be well packed as the ice is stowed. In all cases a covering equally thick, of the same material, should be spread over the ice. An inner sheathing of boards is of service in keeping the sawdust or other filling in its place while the ice is being stored and also when the supply has been considerably reduced. When the wall of an ice-house is made of brick or stone it should always have an inner sheathing of boards.

The roof should have broad eaves to throw rain away from the foundation, and for a similar purpose earth should be banked well up about the walls. A space should be left under the eaves on both sides to admit a free passage of air through the house ; otherwise the air, if confined, becomes warm from the action of the sun on the roof, and the ice will quickly melt.

Unless a small cold room is made in one corner of the house, with a vestibule and double or triple doors to cut off the access of warm air from without, it is better, in warm weather, to open the house only very early in the morning or toward dark in the evening, when a supply of ice can be transferred to an ice-box. A cold room connected with an ice-house is very often of great ser-

vice in preserving meat, fruit, milk, etc., and but little ingenuity will be required to arrange it so as to be sufficiently commodious without encroaching very considerably upon the capacity of the ice-room.

There is a method of constructing "ice-wells," as they are called, in places where a structure above ground would be unsightly, or where the expense of a building is sought to be avoided. For the first reason, they are quite commonly found at sea-side resorts. The adjoining illustration shows one in section. A tapering pit

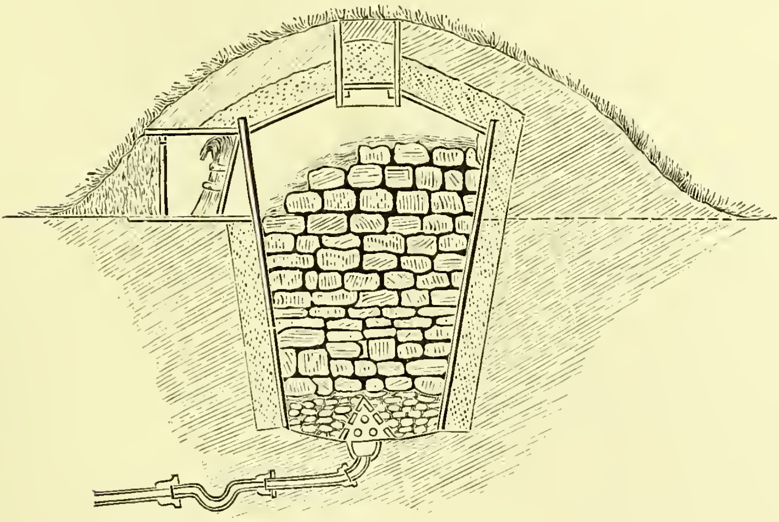


FIGURE 174.—An ice-well.

being dug and a drain constructed to carry water away from its funnel-shaped bottom, a sheathing of boards is put in, having a space of eight to twelve inches between it and the ground. Into this space saw-dust is tightly rammed. A sloping roof is added, through the apex of which a curb is so fixed that the well can be easily filled. After the ice has been securely packed, a trap-door is put into place, and the curb is packed with saw-dust and earth in the manner shown. The roof is also covered with a layer of saw-dust, and outside of this the earth removed from the well is closely packed and its surface sodded. The entrance should be closed by two doors, and, as an additional protection, bundles of straw may be packed against the inner one.

Mr. William Eassie, of England, in his little work on "Healthy Houses," gives a number of illustrations of different methods for constructing ice-houses and ice-wells, and appends the following practical directions :

"When filling the ice-well, stow away the first ice of the season, taking care that it is free from dirt, and, above all, from snow. In stowing it in the well, avoid mixing it with straw, as this will render it very porous. Choose also as clear a day as possible upon which to cart home the ice; and when dealing with pond-ice, break up the cakes with a mallet to a coarse powder and ram it well down, throwing a little water upon it occasionally to facilitate congelation. Some sprinkle the ice with salt and water, one pound of the former to one gallon of the latter, out of a watering-pot, at intervals of two feet up to the top, pouring on an extra quantity when the well is filled up. This cold-water treatment makes the ice so solid that it will yield to a pick-axe only, and an ice-well should always be built sufficiently wide and shallow to admit a man with such an instrument."

Ice-boxes for constant use need only to be made of two ordinary packing-boxes with their covers, one box being sufficiently larger than the other to leave a space of three inches between their sides in all directions when the small one is placed inside of the large one. This space should be filled with finely powdered charcoal closely packed. A tube should pass downward from the bottom of the inner box to carry off water, and this tube should be bent up at its end so as to make a water-valve and prevent access of air. It is desirable, also, to line the interior of the inner box with zinc to prevent its walls becoming foul and to enable it to be kept clean.

There are many localities where ice does not form on most bodies of water, but nevertheless where there are frosts during the cold season of the year. In these places the collection of ice may be accomplished by exposing water in shallow vats protected from wind and open to the sky, so as to permit evaporation. On a clear night a coating of ice will often form under these circumstances if the water is kept free from motion.

To produce cold with the aid of other means than ice alone, a great variety of compounds may be employed, and may serve certain special purposes or in emergencies. A number of these will be found among the Recipes and Formulas in the Second Volume. —Ed.]

Sunlight.

A vast body of evidence conclusively establishes the inestimable value of this agent to the health of both body and mind. Compare the bright, ruddy, happy faces and buoyant spirits of those who reside in the country and work in the open fields, and

upon whom the sun is generally shining, with the pale, phlegmatic faces, emaciated and stunted forms and the nervous depression of those whose vocation in life deprives them of the health-giving and beneficial influence of light. It may be asserted as an indisputable fact that all who live and pursue their calling in situations where the minimum degree of light is permitted to penetrate, suffer seriously in bodily and mental health. Where light is not permitted to penetrate, there are found, in the highest state of manifestation, bodily deformities, intellectual deterioration, crime, and disease. "Where light is not permitted to enter the physician will have to go," is the translation of a well-known Italian proverb. From the earliest period in the history of medicine solar heat was considered to prolong life. "Old men," said Hippocrates, "are double their age in winter, and younger in summer." If the light of day contributes to the development of the human form and to the cure of disease, it becomes a duty to construct our houses so as to allow the life-giving element the fullest and freest entrance. A dark room is always unhealthy; want of light stops growth.

Employment of Good Mechanics.

However well devised the plan of a proposed house may be, however conscientiously an architect may supervise the work, his skill and knowledge will avail but little if the work is intrusted to incompetent or unscrupulous mechanics. It is not in the power of the architect to force an unskilful mechanic to do good work, neither can his utmost vigilance prevent an unscrupulous man from fraud and deception in places where it can readily be concealed. Yet clients often insist upon employing such men because they have rendered a low estimate, and demand of the architect to see to it that the ignorant and unprincipled shall do as well as the most competent and upright workman. Were this less frequently the case, we would hear less of sewer-gas, and there would be less money paid for repairs.

CARL PFEIFFER.

Disease: its Nature, Causes and Manifestations.

BY

HENRY HARTSHORNE, A.M., M.D.,

OF PHILADELPHIA, PA.,

LATE PROFESSOR OF HYGIENE IN THE UNIVERSITY OF PENNSYLVANIA, AND PROFESSOR OF PHYSIOLOGY, HYGIENE AND DISEASES OF CHILDREN IN THE WOMAN'S MEDICAL COLLEGE OF PENNSYLVANIA, ETC., ETC.

DISEASE: ITS NATURE, CAUSES, AND MANIFESTATIONS.

To understand disease, we must define health. What is health? It is that condition of a living body in which its vital energy is unimpaired, and all the functions of every part are, or may be, performed in accordance with the natural law and purpose of their being. *Dis-ease* (like the French *malaise*) must once have meant merely the state of being *ill at ease;* it has come to mean more usually *disorder*, including not only suffering, but disturbance, in various modes, of the system.

In several distinct ways disorder and disease may occur. 1. *From a deficient original endowment of vital energy.* So, some infants are still-born (although, of course, other causes of still-birth exist), and others die as "of old age," *i. e.*, of natural decline, a few weeks, months, or years, after birth. 2. *From a congenital* (that is, existing from birth) *defect of development of some organ or organs.* Thus cyanosis, or the "blue disease," seen in newly born infants, results from an imperfect condition, either of the pulmonary artery, going from the heart to the lungs, or of the valves of the heart. Congenital hernia, or rupture, is a protrusion of a part of an intestine, or of its thin serous cover, most often at the umbilicus or navel. 3. *Disturbance of the action, or function, of some organ* by an interfering cause. Examples of this are seen in the effects of alcohol or opium upon the brain, in intoxication or stupor; and in those of strong coffee, with many persons, upon the heart, perceptibly increasing its action, and producing "palpitation." 4. *Change of the very substance or structure of an organ;* inducing, of course, alteration in its action. Wounds, burns, corrosive poisons, etc., and also the continued influence of disturbances such as some of those above mentioned, will often cause "organic" or structural changes, in the heart, lungs, brain, liver, kidneys, etc. Also, organic changes may be brought on by the continued or repeated influence of a "morbid poison," as, for example, malaria; that is, the local cause, affecting the atmos-

phere, which gives rise to ague and remittent fever. Enlarged spleen and diseased liver are among the common results of this agency.

LOCAL DISORDERS.

The principal states of disease to which particular parts or organs of the body are subject may be described as follows:

Irritation.

Irritation is often undesirably confounded with *stimulation*. An organ may be stimulated, that is, excited beyond its ordinary action, and yet the character of that action may be healthy, and only fatigue may result. Excessive stimulation, especially when repeated often and at short intervals, exhausts and enfeebles. But *irritation* is always morbid. An eye is irritated when a grain of sand, or an inverted eyelash, gets between the ball and the eyelid. The stomach and bowels may be irritated by green apples or other unwholesome food. A mustard-plaster applied for a short time may only stimulate the circulation, making the surface red and warm for a while. But if it be left on longer, irritation occurs; made known in this, as in most other cases, by pain and soreness to the touch.

Congestion.

Congestion is accumulation of blood in a part. During health the quantity of blood passing through particular organs often varies very much. The brain has its circulation most active when under emotional or intellectual excitement; least so at the time of natural sleep. The sexual organs, also, are liable to great variations in their circulation. Healthy determination of blood is not called congestion. But if, when stimulation invites a great deal of blood to a part, the veins are not allowed (*e.g.*, on account of some obstruction) to carry it off again with sufficient promptness, an overloading, engorgement, or congestion results. Sometimes the blood-vessels are weak and relaxed, so as to become stretched with blood; and then some cause may occasion a rupture of a smaller or larger artery. Hemorrhage from the lungs may thus occur; or rupture of a blood-vessel or vessels within the brain, with consequent effusion of blood, constituting apoplexy.

Inflammation.

Redness, heat, swelling, and *pain* are the familiar signs by which every one knows a part to be inflamed. No one of these indications will alone suffice. A part may be reddened by a moderate and temporary stimulation; as when a part of the skin is briskly rubbed for a few minutes. Warmth, or even decided heat of a part, may be innocently produced in the same way; or it may occur all over the body as a symptom of fever without any local inflammation. Swelling may ensue from watery effusion, *i.e.*, dropsy, local or general. Pain may be neuralgic, that is, affecting a nerve or nerve-centre, in the absence of inflammatory action.

The redness of an inflamed part results from an excess of blood in and around it. Heat is increased by the same cause, but is probably also added to by the change going on (oxidation, analogous to combustion) at the centre of the inflammation. At that centre nutrition (healthy formation and repair) is arrested. Stoppage of the ordinary movement of blood through the smallest (capillary) blood-vessels takes place, and, under what is called reflex nervous influence, an excitement of the surrounding circulation follows; with throbbing vessels, beating, as it were, upon and towards the obstructed part. Thence comes the swelling; consisting of enlarged blood-vessels and fluid, the watery portion (serum) of the blood escaping under pressure from the vessels into the substance of the part inflamed. The pressure has also, no doubt, much to do with the production of pain.

The damage done by inflammation depends upon its violence and duration, and upon the character of the organ involved. An *acute* attack of inflammation may pass away after a few days of pain, soreness, etc.; or it may have matter forming (suppuration); or the changes may be so serious as to destroy the texture of the part affected.

Acute inflammation may terminate, 1, in *resolution;* that is, in early and complete recovery; 2, in *effusion of serum or lymph,* as is seen in a blister under the raised outer skin or cuticle; or, much more seriously, in the watery accumulation in the chest in severe pleurisy; 3, in *suppuration, i.e.*, the formation of pus or matter, as in an abscess, or a common boil; 4, in *mortification,* or the death of the part, which only occurs from the most intense inflammation; and indeed very rarely except when there is a predisposition to it from lowness of vitality in the system.

Much more would have to be said in a technical work concerning these results of inflammation; but it may further be added, that

effused lymph often produces *adhesions*, *enlargement*, *hardening*, etc., of parts, in some instances only made known by examination of the body after death. By means now well known, however, a skilful physician will in many instances be able to detect the signs of such changes during life. *Specific* inflammations, as those of gout, rheumatism, syphilis, diphtheria, small-pox, etc., are attended by peculiarities belonging to the history of the diseases respectively thus named.

Chronic inflammation is a designation applied to a state of things in which redness, heat, swelling, and pain (or soreness) persist for a long time, without that escape of lymph from the blood-vessels which characterizes attacks of acute inflammation. The most easily observed instance of this is in the eyes; which, not unfrequently, exhibit a distressing and rather obstinate "chronic inflammation," especially involving the outer coat (conjunctiva) of the eyeball, and the inner and outer portions of the lids. Chronic inflammation of the stomach (gastritis) is made known by indigestion, attended by pain and tenderness on pressure over the stomach; the latter symptom being generally absent in ordinary dyspepsia.

Hypertrophy.

Enlargement of various organs of the body may occur, especially in two ways: *over-growth*, and *dilatation*, or stretching and thinning. The heart best of all exemplifies these changes. Sometimes it grows like any other muscle, thicker as well as stronger, from unusual work; as when an obstruction of one of the heart-valves calls for extra labor in the contractile walls, to force the blood on in its circulation. Other instances there are, in which, under similar circumstances, instead of growing thicker, the heart dilates, becoming thin and weak in its action.

True enlargement may take place in other parts of the body, with or without growth of their natural tissue or substance, which may be substituted by an inferior kind of material. An enlarged liver or kidney is almost sure not to be composed of entirely healthy liver or kidney substance.

Atrophy.

This is the very reverse of hypertrophy. Old age presents it in many cases as a general body-change; indeed this is the most simple and natural effect of advanced age. The fat is first absorbed and removed; then the muscles shrink away; other organs

follow, the softer first, including the brain; until at last, with the universal drying up, life goes out.

Atony is a term much less used, indicating relaxation and weakness of a part, without diminution or essential alteration of its substance; in other words, loss of tone. In dyspepsia this is the condition of the stomach, which may be palliated, if not relieved, by vegetable bitters and other tonic medicines.

Degeneration.

By this we mean a lowering in the character of the substance of an organ, under impaired nutrition, so that it is not capable of doing its proper part in the system. Here, again, we find the best example in the heart, in "fatty degeneration" of its muscular structure. For many of the fibres of muscle, lines of fat are substituted; of course weakening the heart in its action and rendering it liable to sudden and fatal failure, or rupture from exertion.

Degeneration of the arteries may occur in different parts of the body; in the brain, for instance, predisposing to apoplexy. All degenerative changes are most common in old age; but they are not peculiar to it. Depression of vitality at any period of life may induce them. Sometimes organs, while undergoing degeneration, *harden*, from the nature of the deposit of altered tissue; in other instances, *softening* takes place. Brain substance may undergo either or, successively, both of these changes.

Effusion, or Dropsy.

We have alluded already to a blister, as affording the simplest case of inflammatory effusion of fluid having escaped from the blood through the walls of the vessels in the skin. Pleurisy, *i.e.*, inflammation of the pleural membrane which wraps the lungs and lines the cavity of the chest, is, in severe cases, attended by a similar effusion, sometimes large in amount. A denser and much less abundant effusion of "coagulable lymph" occurs in many cases of pleurisy; inducing portions of the pleura to adhere together. This, when an effort is made to expand the lungs in breathing, is a cause of the acute "stitches" of pain in the side which characterize this disorder.

Inflammation of the membranes of the brain may, likewise, result in a dense, plastic "exudation," or effusion, sometimes causing the two hemispheres of the brain to adhere at their base; or, either instead of or together with this, a serous or watery effusion and accumulation may take place. Also, the same things

exactly may happen in the abdomen in peritonitis ; *i.e.*, inflammation of the peritoneum, the thin, delicate membrane which lines the abdominal cavity and wraps in its folds all of the organs contained therein.

Sometimes the fluid, thin and transparent at first, becomes, either gradually or quite rapidly (mostly the former), changed to pus, which is a yellow fluid, seen by aid of the microscope to consist, chiefly, of minute roundish particles, called pus-cells. This indicates a much more serious state of things than when the effused liquid is watery in character ; and the removal of the pus, by either a spontaneous or an artificial opening, becomes then of great importance.

Other causes, however, of watery effusion often exist, besides inflammation. *Dropsy* may be either *general* (anasarca) or *local.* The latter, when occurring in the areolar (cellular) tissue under the skin, or, in one of the mucous membranes (as that of the larynx or upper windpipe) is usually called *œdema.* *Air* accumulating under the skin, or in any porous organ or tissue, and producing distention, constitutes *emphysema.* Local dropsy is named according to the part of the body affected. *Hydrothorax* is dropsy of the chest ; *hydrocephalus,* that of the head ; *ascites* is abdominal dropsy, etc.

General dropsy may be brought on by sudden suppression, or great diminution, of the flow of perspiration, and of urine ; as by exposure to cold and wet. The large amount of water, whose natural and needful escape from the body by the skin and kidneys is thus prevented, distends the blood-vessels, and oozes or transudes through their coats, either under the skin or into internal cavities, or both at once. When the heart, liver, or kidneys have been for some time the seat of disease, the circulation of the blood may come to be so obstructed, that its watery portion (serum) is expressed, as it were, making dropsical accumulations. Not only slow or chronic disease of one of the great organs mentioned may have such an effect, but an acute disorder, *e.g.*, scarlet fever, by acting injuriously upon the kidneys, may induce serious and even fatal dropsy. [See, also, Volume II.]

Mortification—Gangrene.

Death of a part of the body is designated by the above terms, which are synonymous. *Sloughing* is another word of similar meaning. A crushed or frozen foot or hand, arm or leg, may mortify. Gangrene of a lung occasionally results from a low form of pulmonary inflammation. Mouth-gangrene, in debilitated chil-

dren, is more rarely met with. In old persons, "senile gangrene" may occur in one or both feet, without any injury to produce it. Obstruction of an artery, as by a clot (embolism), may bring on mortification at any time of life. The tearing of an artery at the same time with the fracture of a bone, by a gunshot or other wound, endangers the same consequence.

Hospital gangrene is met with in surgical hospitals whose atmosphere is close and polluted; where wounds and parts operated upon, as amputated limbs, instead of healing *slough*, and a state of depression ensues which is usually fatal. *Pyœmia*, which frequently accompanies gangrene, means, literally, "purulent blood," or blood containing pus. It is a constitutional affection, attended by general prostration, low fever, and the formation of pus-deposits in different organs or portions of the body.

Morbid Growths.

For a full account of these, reference must be made to works on Surgery and Pathology. For our present purpose, the most important statement is in regard to the difference between *innocent* or *benign*, and *malignant* tumors. Fibrous and fatty growths belong under the former head; although, in some localities, the inconvenience and suffering produced (as in cases of fibrous tumors of the womb), may be such that the term innocent is hardly descriptive, and is applied only as a measure of comparison. *Cancer* is a name generally suitable for *malignant* growths; which, although varying much in character, agree in their common tendency to indefinite extension and destructive changes, involving neighboring tissues in their own morbid condition and, at last, destroying life. Even if removed by a surgical operation, a truly malignant tumor, a cancer, will more often than not (unless very early removed) again commence to grow at the same spot; or some internal organ will take on the same sort of action, and a cancer of the lungs, liver, or brain, etc., will follow. [See, also, Volume II.]

Among comparatively innocent growths, besides fatty and fibrous tumors, may be named *exostosis*, or enlargement of bone: and *vascular* growths, often called *moles*, such as those upon the head, with which some infants are born. Also, every one is familiar with *warts*, which exhibit over-growth, with alteration of the outer and middle layers of the skin; as well as *corns* and *bunions*, in which the cuticle or outer skin is excessively developed, with or without inflammation of the parts beneath it.

GENERAL DISORDERS OF THE SYSTEM.

Fever.

Heat is, in all languages, the essential meaning of the word corresponding with our term fever ; and unnatural heat of the surface of the body is the most characteristic symptom of the condition so named. With this symptom, however, we have also in fever general weakness, dryness of the skin, scantiness of urine and of discharge from the bowels, thirst, rapidity of pulse, and, generally, headache ; sometimes delirium or stupor.

Fever is not a *disease*, but a condition or a combination of symptoms. It is very often, but not always, preceded by a cold stage or chill. In this, there is a sense of weakness, mostly of general discomfort, with pallor of countenance, deepening sometimes into blueness of the lips, as well as of the hands ; coldness of the hands, feet, lips, and nose, with a more or less shrunken appearance of the face and of the skin over the body ; often with pains in the back and lower limbs, and not unfrequently vomiting. In the marked chill of ague or intermittent fever, rigors, or tremors of the whole body, and chattering of the teeth, are common. The worst form of chill is that of "congestive," or pernicious intermittent ; seldom met with in the Northern United States, but not rare in the South. The prostration and coldness in this affection exhibit a resemblance to the *collapse* of epidemic cholera, in which the skin is cold and blue, the pulse almost absent, breathing difficult, and the patient is prostrate to the last degree.

The condition of fever may be attendant upon many different kinds of disorder. *Intermittent* is closely allied to *remittent* fever; only in the latter the heat, rapidity of pulse, etc., do not entirely go off or intermit, but merely *remit* or lessen considerably ; and then an *exacerbation* or return of the violent febrile symptoms occurs. With intermittent (ague), a cold, hot and sweating stage make a paroxysm ; and this may recur every day (*quotidian*), every other day (*tertian*), or every fourth day (*quartan*) ; or, even at the end of each week or two weeks. In remittent fever, a remission usually occurs every day. *Periodicity* is the special characteristic of these disorders, both of which are included under the designation "malarial (also autumnal) fever," being referred to the same local and seasonal cause.

Again, when any important organ of the body, as the lung, brain, bowel, etc., is acutely inflamed, fever accompanies, or results from, the general disturbance produced by the local disorder.

Pneumonia is a febrile attack of inflammation of one or both lungs; pleurisy also, and pericarditis (inflammation of the outer covering of the heart), and meningitis (inflammation of the membranes of the brain), as well as inflammation of the bowels (enteritis), are all commonly attended by considerable, often by violent fever.

Typhus and typhoid fevers are two forms or varieties of continued (as distinguished from remittent and intermittent) fever. Slowness of progress, great debility, and tendency to stupor, are common to them both. Differences exist, however, sufficient to mark them as distinct diseases. Yellow fever, relapsing fever, and spotted (or cerebro-spinal) fever are specific febrile disorders, each having its characteristic features and history; and the same is true of scarlet fever (scarlatina), as one of the "exanthemata" or eruptive fevers; to which list belong also measles and small-pox.

Depression, Exhaustion, Prostration, etc.

Weakness, of various kinds, is so frequent a condition, that some have imagined it to be almost the whole essence of disease; the only difference being as to the part or parts of the body suffering debility. It *is* the most general fact, common to all disorders, that weakness of the whole body or of one or more of its organs, exists *either as a cause or as an effect*. It is an important truth, however, that debility is not the whole of either local or general diseases. For instance, in small-pox, a special poison or contagion is the direct causative agent; in yellow fever, a local morbid infection; in acute indigestion, irritation from some unwholesome food, etc., etc.

There are different *kinds* as well as degrees, of weakness. Of these, the simplest is *exhaustion*, from excessive or too long continued labor, extreme mental excitement, or loss of sleep. Closely allied to this is *prostration*, such as follows copious loss of blood, or very severe diarrhœa or cholera morbus, or the continuance of any serious attack of disease. *Depression* may attend a shock to the system, as from a severe wound in battle, a railroad accident, an extended burn or scald, or a sudden alarm or very painful mental impression. [See also Chapter on Accidents and Emergencies.] Some morbid poisons depress the vital energy greatly; as *e. g.*, that which produces the collapse of malignant cholera, or that which causes the cold stage of intermittent fever. *Oppression* is a term which more fittingly applies to the debility of moderate affections of analogous kinds; as, the first stage of a severe cold, or that of measles, scarlet fever, or small-pox. In typhus and

typhoid fevers, as well as in yellow and relapsing fevers, the early stages exhibit rather depression than oppression; later, prostration or exhaustion comes on. But it is of great consequence as to the treatment of conditions of weakness, to observe that what we have called oppression is, very often, a kind of counterfeit, or at any rate transitory, debility; requiring relief of certain organs and functions (as by purgative medicines, increase of perspiration, urination, etc.), and *not* demanding support by stimulation.

Another case of obvious weakness is that brought on by any agency which overpowers the brain; as in the drunken state, opium poisoning, etc. In this condition of things, to rid the system of the injurious agent, or to keep the patient alive long enough for the natural functions to throw it off, is clearly what is wanting. Such is a very different kind of debility from that met with in persons exhausted by loss of blood, or by three or four weeks' continuance of typhoid fever, or by pulmonary consumption. These last states require support by concentrated food, and, often, careful and judiciously limited stimulation.

Anæmia.

By this term physicians are accustomed to designate *poverty of blood.* It is known that human blood (as seen under the microscope) consists of a *fluid* and *corpuscles*, the latter being very minute and numerous particles, whose uses are very important to the system. The red corpuscles, which give color to the blood, contain iron. If their number comes to be deficient, or their condition unhealthy, pallor, weakness, and "nervousness" or nervous irritability, and often neuralgic pains, result. In women, derangement of the menstrual function often attends the anæmic state; sometimes *amenorrhœa* (arrest or postponement of menstruation), and in other cases the reverse, *menorrhagia*, excessive or too frequent menstrual discharges.

Leukæmia.

Leukœmia, or leucocythæmia is a much less common affection, in which, with or without an absolute deficiency of the red corpuscles of the blood, the *white* or colorless corpuscles are in excess. Here, also, along with other symptoms not needful to be here recounted, debility is usual, as well as pallor of the countenance and general surface of the body.

Plethora.

Here we have the contrary of anæmia; the blood contains an excess of red corpuscles; it is over-stimulating in quality, and the system exhibits signs of repletion. The face is red, the vessels of the surface being full and enlarged. Hemorrhage from the nose, or even from the lungs, is not uncommon, and may relieve the condition present; which is otherwise liable to the occurrence of acute congestion or inflammation of the brain, lungs, or liver, under any exciting causation. Plethora is most frequent during youth or early middle life; but it is most dangerous in old persons, because of the predisposition of the latter to hemorrhage upon or within the brain, causing apoplexy.

Cachexia.

Bad constitutional habit is the meaning of this term. *Anæmia* and *leukæmia*, and even *plethora*, already spoken of, might come under this designation. But it is more usual to apply it to still more perverted conditions or tendencies of the system; especially those involving the processes and organs of nutrition, *i.e.*, blood-supply, tissue-formation, and repair.

Scrofula is one form of cachexia. An old name for it is "king's evil," it having been, until as late a period as the time of Charles I. of England, a popular belief that the touch of a royal hand would cure it. Swellings of the glands of the neck, etc., these glands often softening slowly and discharging a cheese-like material; chronic inflammations of the eye, nose, and ear; slow inflammatory affections of the bones or joints; also, slowly progressing and wasting disorders of the lungs, bowels, and brain; all of these have been generally classed as scrofulous affections. [See, also Volume II.]

Closely allied to, if not identical with scrofula, is tubercular disease, or *tuberculosis*. Best studied in the lungs, tubercles are small masses of morbid material, taking the place of healthy tissue, described generally as being gray, semi-transparent, or yellow, hard or soft, mostly varying from the size of the head of a pin to that of a pea, but occasionally still larger.

A mass of tubercles deposited in a lung, and softening, will leave a cavity (*vomica*) sometimes of considerable size. In other cases one or both lungs may be gradually almost transmuted into tuberculous material (tuberculous infiltration), of course obstructing, and at last putting an end to, the patient's capacity of

breathing. Hectic fever, night sweats, emaciation and debility, as well as frequent and distressing cough, with copious expectoration, attend such a state of things. [See also page 310, and Volume II., Chapter on Diseases of the Respiratory Organs.]

Scurvy.—*Scorbutus* is the technical name for this long known affection, once more frequently met with than now. Before its causes and proper means of prevention were understood, men at sea on long voyages, armies, explorers in foreign countries, and travellers or sojourners in cold climates, were very often subject to it. Captain Cook, the great navigator, is credited with discovering that the principal cause of scurvy is deprivation, for long periods, of fresh vegetable food.

Chlorosis, or "*Green sickness*," on account of the peculiar sallowness connected with it, is a popular name for a disease which is met with almost exclusively in young women. It is not a common affection. Nearly always it occurs in those who are *anœmic*, and suppression or irregularity of the monthly courses is present in many cases.

Goitre and *Cretinism.*—The former is enlargement of the *thyroid gland*, which is naturally small and thin, situated upon the lower front portion of the throat. This enlargement may occasionally take place without any marked constitutional defect. But, in certain mountainous regions, families residing in narrow valleys, among the Alps, Himalayas, and Andes, to a less extent also in the Green Mountain region of Vermont, are especially subject to goitre (*bronchocele*), the size of the gland sometimes becoming enormous. With this, in Switzerland, there is often associated a tendency during childhood to stunted growth and imperfect development of the brain, with idiocy or *cretinism* as a result. Often those removed, when young, from their unhealthy homes to high, sunny, and airy localities, have, in a few months, been cured of their goitre, and otherwise much improved in health. [See also Volume II.]

Rickets.—We know a "rickety" child by the generally imperfect development of its locomotor apparatus, *i. e.*, the bones and muscles. In bad cases the spine becomes curved, the limbs are out of shape, the bones are easily broken, and the teeth come through the gums late, or decay prematurely. Depending chiefly upon deficiency or unwholesomeness of food, this morbid habit of system is much more frequent among the poorer classes in the great cities of Europe than in those of America. [See Vol. II. for further description.]

Syphilis.—Elsewhere in this work the reader will find syphilis considered. Here it is important merely to note some facts regard-

ing it as a cachexia. This term is applicable not to primary or local, but only to constitutional or *secondary* and *tertiary* syphilis.

Constitutional syphilis follows the primary, the latter being generally incurred through the contagion of impure sexual intercourse. Hereditary transmission of constitutional syphilis is a marked fact of great consequence. When inherited, the symptoms are essentially of the same character as when following the original primary disease. *Secondary* syphilis is the name commonly given to the disease, so long as the parts affected are the mucous membrane, skin, hair, and iris (surrounding the pupil of the eye). *Tertiary* syphilis is the series of somewhat later affections of the bones, testicle, womb, liver, brain, or other internal organs. Copper-colored eruptions upon the skin, ulcerations of the throat, and nodes or hard round swellings upon the bones, are the most familiar manifestations of the syphilitic cachexia.

Toxæmia: Blood-Poisoning.

So necessary is the blood to all the processes of life and to the functions of living organs, that its alterations, unless very slight and transient, must affect the condition and action of the whole body. By its constant interchange of material, also, with all the organs, the blood is subject to the influence of their disorders. If, for instance, perspiration is suppressed, the blood continues to be loaded with matters which the skin should have excreted, *i. e.*, removed and carried out of the body. The kidneys may, and very frequently do, act vicariously for the skin. But the disturbing cause (*e. g.*, exposure to cold and wet) may at the same time affect both the kidneys and the skin, and then the blood must become contaminated. Ingredients, which normally pass out with the urine, remaining in the blood, a morbid condition called *uræmia* is produced. When this reaches its worst degree, the brain and other organs are dangerously, at last fatally, oppressed. Stupor and convulsions are among the symptoms which manifest this kind of blood-poisoning.

Constipation of the bowels, continued for some time, brings on contamination of the blood by re-absorption from the lower intestine, through its blood-vessels, of material already excreted by the intestinal glands. Also, these glands may fail to do their proper work of eliminating from the blood its putrescent waste-substances.

Cholœmia, or *cholesterœmia*, are terms applied to blood-contamination due to insufficient action of the liver, a part of whose use in the body is to secrete daily from the blood, a material

which, by the minute liver-cells, is converted into bile ; the latter being either passed directly into the small intestine, or accumulated for a time in the gall-bladder.

But there are other ways of blood-poisoning. After child-birth if a portion of the placenta (after-birth) remains attached to the interior of the womb, and there undergoes decomposition, unless measures of purification are used, putrescent matter may be absorbed into the blood. *Septœmia*, or *septicœmia*, are names given to such a result. *Pyœmia* is the designation often loosely applied to the same condition of things ; but, strictly speaking, *pyœmia* means *purulent* blood ; pus being absorbed and carried by the veins, so as to be deposited in various parts, as the lungs, the tissue under the skin, the joints, etc. A low form of fever, with debility, frequently fatal, accompanies the pyæmic and septæmic states.

Toxœmia is, furthermore, an appropriate term for the primary and most essential condition in many diseases, often called *zymotic* disorders (from *zumoo*, Greek, *to ferment*) ; on account of a certain analogy in their causation to that of the fermentation of vegetable juices. Under this head come all contagious and locally infectious disorders, as small-pox, measles, scarlet fever, whooping-cough, yellow fever, cholera, intermittent and remittent fevers, diphtheria, etc. All of these are undoubtedly due to the introduction into the body of *something from without*. What that something is, in a few instances, notably that of small-pox and the vaccine disease (purposely produced in vaccination to *prevent* small-pox), we know, by positive observation. It is a *virus* or contagious material, of recognizable properties. In other instances, as those of measles and scarlet fever, the analogy of small-pox gives satisfactory reason for believing that the cause, although not demonstrated, must likewise be a subtle and more or less volatile material. This enters the blood and sets up therein a morbid process of change, whose results are the symptoms and the constitutional and local effects belonging to each disease.

Much interest has been taken of late years in the question, whether the causes of these transferable and transportable maladies may not be minute *living organisms*, which, like the itch-animalcule (discovered and accurately studied by aid of the microscope), pass by contact or through the air or water, from person to person, or from place to place. The affirmation of the reality of such a mode of causation and propagation of various maladies is known as the "Germ Theory of Disease." [This is discussed more fully in the chapter on Acute Infectious Diseases.]

CLASSIFICATION OF DISEASES.

Many methods have been proposed for grouping diseases according to their resemblances and diversities. The following is at least as simple and intelligible as any other. Diseases may be named and distinguished thus: 1. Inflammatory affections; 2. Contagious and infectious, endemic and epidemic diseases; 3. Chronic constitutional and local affections, or cachexiæ; 4. Disorders of the nervous system; 5. Unclassifiable diseases.

Of *inflammatory* affections, we may name as examples: ophthalmia or inflammation of one or both eyes; pleurisy or inflammation of the pleura, the delicate serous envelope of the lungs within the chest; bronchitis or inflammation of the bronchial tubes, which convey air in breathing to the lungs; laryngitis or inflammation of the larynx, or upper part of the windpipe; pericarditis or inflammation of the pericardium, the sac which surrounds the heart; peritonitis or inflammation of the serous membrane enveloping all the organs in the abdomen; enteritis or inflammation of the bowels, etc.

As *contagious* diseases, may be mentioned syphilis, small-pox, typhus, measles, scarlet-fever, mumps, whooping-cough, hydrophobia. *Locally infectious:* yellow fever *endemic* (peculiar to certain places at certain times), malarial fevers. *Epidemic* (extending or migrating from place to place), malignant or Asiatic cholera.

Closely allied to these in the manner of their causation, but more obscure in their origin, are typhoid fever, spotted or cerebrospinal fever, relapsing fever, diphtheria, erysipelas, and influenza. All of these belong to the group called by a number of writers, *zymotic* diseases.

Cachectic affections are exemplified by pulmonary consumption, chlorosis, cancer, diabetes mellitus, Bright's disease, secondary and tertiary syphilis, leukæmia, goitre, cretinism, and scurvy. More readily than elsewhere in our classification, we may place also under the same head, gout, rheumatism, pyæmia, and septæmia, organic degenerations—such as fatty degeneration of the heart—and certain chronic skin diseases, *e.g.*, eczema, psoriasis, etc.

Under *disorders of the nervous system* may be enumerated neuralgia, epileptic and other convulsions, chorea (St. Vitus's dance), hysteria, tetanus (lockjaw), apoplexy, paralysis (palsy), delirium tremens (mania à potu), insanity, etc.

Unclassifiable, at least in any of the foregoing divisions, are the following disorders: dyspepsia, colic, cholera morbus (not epidemic), diarrhœa, jaundice, hemorrhages, dropsies, worms, etc.

COURSE OF DISEASES.

Many affections present all of the following successive eventualities: the *incubation*, a stage of *depression*, a period of *reaction* (fever), *convalescence*, and *sequelæ*. Or, if not recovered from, after the period of reaction, or without it, follows *exhaustion*, ending in *death*. Nervous disorders, however, and cachexia, may have no such stages.

The *remote causes of death* are almost as numerous as the disorders "which flesh is heir to." The sting of a bee has, occasionally, and the stings of many bees at once have often produced death. By inducing lockjaw (tetanus), a seemingly trifling injury, as a punctured wound of the hand or foot, may have a fatal effect. Persons in a condition of debility may die of exhaustion from some over-exertion or nervous shock, such as would have had very little effect upon a vigorous system.

Immediate causes of death, that is, those traced by analysis of the last changes preceding dissolution, may be named under the following heads: 1. *Asphyxia*, or *apnœa;* death by arrest of breathing; the lungs being rendered incapable of, or entirely obstructed in, their function. 2. *Coma*, or *aneuria;* death by extreme oppression of the brain, or exhaustion of the energy of the great nerve-centres. 3. *Anæmia*, or blood-impoverishment pushed to its last degree, so that the blood can no longer support the vital organs in performance of their functions. 4. *Asthenia*, or simple prostration or exhaustion; the heart ceasing to beat, while other organs, as the lungs and brain, may be still capable of continuing their functions.

Of death "by the lungs," or *apnœa* (cessation of breathing), the termination of a rapid case of double pneumonia may be named. Or, that of some (not all) cases of pulmonary consumption. Or, that of fatal (mostly "membranous") croup; as well as drowning, strangulation, suffocation with irrespirable gases, etc.

Coma is the condition preceding death in apoplexy, opium-poisoning, compression of the brain from fracture of the skull, etc.

Anæmia becomes fatal when the blood is impoverished to an extreme degree by copious hemorrhages (as from wounds of blood-vessels), or excessive discharges of other kinds, *e. g.*, diarrhœa; or by starvation. Cancer of the stomach, while otherwise capable of producing death after a longer period, brings it on more rapidly (usually within a year from its commencement) by interfering with the appropriation of food.

Asthenia may reach a point closely imitating death, in *syncope*,

or ordinary fainting. If this be prolonged many moments, the arrest of the action of the heart will constitute actual death.

Old age presents the most natural approach to death when, without change of any of the organs, except by slow atrophy or wasting, the strength declines almost imperceptibly, until absolute exhaustion of the vital energy occurs.

Sudden asthenia may be produced by a poisonous dose of prussic acid; by a stroke of lightning; or, in persons of weak heart, by a violent effort, or prolonged excessive fatigue. Rupture of the heart may take place under like circumstances, when the heart has undergone fatty degeneration. Besides these last named causes of sudden death, this may supervene upon a great mental shock; as that of extreme terror, or violent grief from an unexpected calamity. In such cases the brain must be the recipient of the fatal impression. Apoplexy, with rupture of a blood-vessel or vessels within the head, so that effused blood, coagulated into a clot, presses upon the brain, may determine the result. But there is good reason to believe that a nervous shock may sometimes kill without apoplectic effusion, through *aneuria*, or total paralysis of the chief nerve-centres, which lie at the base of the brain and in the upper portion of the spinal marrow.

Not only fatty degeneration, but also other diseases of the heart, render the subject of them liable to sudden death; as, *e. g.*, valvular heart-disease. Aneurism (morbid partial enlargement) of the aorta may, by rupture and escape of blood, be the occasion of sudden death. More rarely, violent hemorrhage from the lungs may have a like result. Bursting of a large abscess into a lung may cause immediate suffocation. The opening of an abscess (as of the liver) into the abdominal cavity will usually be fatal, but after hours, or, it may be, days of prostration.

CAUSATION OF DISEASE.

This is an extremely complex and extended subject, the study of which has always received much attention from intelligent men, both with a view to the prevention and to the cure of diseases. Hygiene, or sanitary science, is interested in it equally with therapeutics, or practical medicine. Our view of it here must be very brief and general.

Many classifications of the causes of disease have been proposed. The simplest, perhaps, as well as the oldest, is, into *predisposing* and *exciting* causes. Insanity, for instance, may occur in some members of a family, while others of the same family may escape it. Probably there is in that family a predisposition to-

wards mental derangement, while some are, and others are not, exposed to specially exciting causes; as intemperance, disappointed affection, loss of property, etc. Or, again, two children of consumptive parents are differently brought up; one, with a sedentary, in-door life, in a damp locality, "takes cold" easily, and manifests the hereditary predisposition to pulmonary disease quite early; the other, leading an active out-of-door-life, in a favorable climate, may retain good health through many years.

One very important kind of predisposition then, to disease, is *hereditary constitution.* Consumption and insanity have just been mentioned as exemplifying it. Scrofula, affecting the glands, mucous membranes, and bones, is frequently inherited. So is the gouty habit; often modified, however, in the transmission. Epilepsy is hereditary in some families; cancer in others. Early loss of hearing, or blindness, will sometimes appear in several successive generations.

Diseases may have *functional* causation; that is, connected with the use or activity, or, on the other hand, the prolonged disuse of organs. Over-exertion, if very violent, may rupture the heart or aorta, or may bring on general exhaustion. Excessive excitement of the brain, especially in childhood, may produce inflammation or other serious cerebral disease. Sexual excess or abuse is a common cause of disorder of the nervous system and of the heart, as well as of the genital organs themselves. Again, sedentary habits, continued indolence, may, at least, predispose to disease by lowering the general tone of the health. Neglect of the demand to evacuate the bowels may cause constipation, with many attendant evils; among which is a risk of hernia (rupture), *i. e.,* protrusion of a portion of intestine, or of its serous cover, under the skin at the groin or navel. Uncleanliness of the body is promotive of disease by obstructing the pores of the skin, and diminishing transpiration. Obstruction of the lungs by imperfect ventilation, irrespirable gases, etc., may do immediate harm, besides making the system more susceptible to many other causes of disease.

"Catching cold" is the most frequent and familiar instance of the causation of disease by the influence of *surrounding conditions.* Cold and wet, suddenly or partially applied to the surface of the body, will, especially if the body be "below par" in vigor at the time, give rise to an attack of "cold in the head," or "cold on the chest," etc. Frost-bite of the feet or hands, or actual freezing of them, followed by mortification, and the extreme opposite, sunstroke, or heat-stroke, are examples of *conditional* causation.

A very simple mode of derangement of organs, and sometimes

of destruction of life, is that of *mechanical* violence or interference. Besides wounds, fractures, and dislocations of limbs, etc., we may name, under this head, tight lacing, which, by obstructing the play of the lungs in breathing, and the movement of the heart in circulating the blood, has, not a few times, occasioned death.

Unwholesome food, as well as actual poisons, introduced into the stomach, may cause stomachic and general disorder, varying in nature with the circumstances. *Intemperance,* producing various forms of alcoholism, is a prolific and most injurious source of disease. By the injudicious use of medicines many people injure themselves and their children.

*Exotoxæmic** causation is that which is manifested in the production of contagious, infectious, endemic, and epidemic disorders. These have been spoken of already, under the designation of "zymotic diseases." Their morbid causes evidently enter the system from without, although their nature and mode of operation are sometimes mysterious.

Modifying influences affecting predisposition to disease may be spoken of as related to age, sex, and temperament. Infants are peculiarly liable to croup, convulsions, eruptions upon the skin, and diarrhœa. About the time of puberty, bleeding at the nose is more frequent than earlier or later in life. In youth pulmonary consumption is somewhat more likely to occur, in those predisposed to it, than after maturity. Middle age is apt to suffer the penalties of indulgence, in gout, gravel or stone, dyspepsia, liver-disease, heart-disease, etc. In old age the tendencies are to apoplexy, fatty degeneration of the heart, trouble with the urinary organs, and other results and evidences of general and local decline.

Sexual peculiarities in regard to morbid predisposition will be treated of in another chapter.

Temperaments are commonly enumerated as four: the sanguine, nervous, bilious, and lymphatic temperaments. Of these, the *sanguine* is the most excitable, active, and changeable; it is liable especially to inflammatory affections and active hemorrhages. The *nervous* temperament exhibits sensitiveness and irritability in more than usual degree; hence, disorders of the nervous system, as convulsions, hysteria, and neuralgia, are common in those possessing it. The *lymphatic* temperament is the most sluggish and least excitable of all. Troubles of the digestive organs, including the liver, and of the glandular system, are its chief besetments.

---

* *Exo*, from without, *toxæmia*, blood-poisoning. *Esotoxæmia* is that which arises from morbid changes occurring within the body itself.

The *bilious* temperament is described by authors as exhibiting the greatest endurance, and the least susceptibility to morbid disturbances, of all the temperaments. The name applied to it suggests a morbid habit or tendency in the liver, which is the bile-secreting organ; but the other characters of this temperament may be present without any disorder of the liver.

We may characterize the appearances of those having the four different temperaments, briefly, thus: the sanguine is ruddy, and mostly fair; the nervous, thin and wiry; the lymphatic, flabby, and somewhat fat; the bilious, dark and square of build, with a predominance of bone and muscle. It is well to remember that excessive development of either temperament may be favorably modified by careful self-management. Most persons present a combination of temperaments; as nervo-sanguine, bilio-lymphatic, etc.

SIGNS OF DISEASE.

Diagnosis is the term used by physicians to indicate the ascertainment by all available means of the exact state of disorder existing in a patient at the time. A perfect diagnosis will include a knowledge of the condition and manner of functional action, healthy or otherwise, of all the organs of the body. There are often difficulties in the way of so precise a determination of the state of all the organs. The greatest skill of the experienced physician may be, at times, taxed to the utmost to account during life for some of the observed symptoms of disease. As the organs essential to the continuance of life and health are all concealed from view within the head, chest, or abdomen, this difficulty is easily understood; and it is among the noblest triumphs of modern intelligence, perseveringly applied by members of the medical profession, that so much has been done to overcome the obscurity attaching to diseases of the lungs, heart, brain, and abdominal organs. *Physical* diagnosis is a term commonly applied to the examination of the great cavities of the body, to discover, from without, the state of the organs within them, by the alterations in the conditions of the parts of which they are composed. In such inspection the senses of touch, hearing, and sight are all engaged. Other assistance in diagnosis is obtained from *symptoms* which are partly observed by the physician, and in part also communicated by the patient. The physician feels the pulse, looks at the tongue, hears the cough, hoarse breathing, etc., and the patient tells him of his pains, thirst, debility, and other *subjective* signs, *i.e.*, those known only to his own consciousness as their subject.

The diagnosis, obtained by all available means of scrutiny of a case of disease, is the basis of the *prognosis*, or anticipation of the result, as well as of the *treatment*, to promote recovery or to prolong life and relieve suffering. Our mode of consideration of the signs of disease in the present work must differ, in the absence of many technical particulars, from that which would be proper in a strictly medical treatise.

In nothing are the sagacity and knowledge of a really judicious physician more conspicuous, than in his comprehension of the signs determining the *general condition* of an ill person, so as to know whether he is getting better or worse, and whether his vital endurance and resistance are or are not much impaired. This knowledge is gathered, often, almost at a glance by the experienced practitioner. He is acquainted with the *aspect* of different constitutional states, his recognition of which is aided also, of course, by the pulse, heat or coldness of the skin, rate and character of breathing, etc. Still, no careful physician will ever be satisfied with a partial apprehension of the nature of a case under treatment. Often-repeated, minute, and extended examination will be necessary—not to find out *something* about the case (which may be easily done), but to find out *all* about it. Only a hasty or superficial practitioner will be content when he has seen enough of the symptoms to guess out such a combination of them as will seem to warrant a *name* for the disease. It is not according to names, but to actual *morbid conditions and processes*, that scientific medical practice must deal with those who come under its treatment.

Symptoms Affecting the Circulation.

The pulse has, from the earliest times, been regarded as among the most important of the signs by which states of health or disease may be ascertained. In a healthy adult man, while sitting still, the pulse usually beats from 65 to 75 times in a minute; best, when it is slowest within those limits. In a woman the average is about five beats more in a minute. Lying down, the rate is a little slower; standing up, a little faster; on walking the rate is increased, and by running, or other active exercise, it may be raised to 120 or even 140.

Young persons have a more rapid rate of pulse. At birth, it is from 100 to 120; at six or eight years of age, from 90 to 100; then it gradually declines, through youth and middle life to old age. Most persons from 65 to 75 or 80 years of age, have a pulse under 70 in the minute. With decrepitude, however, in very old people,

not unfrequently the pulse becomes somewhat more rapid than it was in vigorous middle life.

Debility, from any cause, when decidedly marked, is mostly attended by *lessened force*, but *quickened rate* of pulse. Occasionally, instead, a very feeble pulse is also a slow one; but this is exceptional.

Fever has, for one of its characteristic signs, a rapid pulse. But, as above shown, this *alone* can never give reason for pronouncing that fever is present.

A very *slow* pulse is met with in cases of *brain-oppression; e. g.*, apoplexy; the middle stage of severe inflammation of the brain; fracture of the skull; opium-poisoning; dead drunkenness.

An *irregular* pulse (dropping or postponing a beat every few moments, or otherwise varying in its rate) is comparatively uncommon, unless in young children. It is connected, usually, with positive disorder either of the brain or of the heart; and is almost always a symptom of serious import. Dr. B. W. Richardson, of London, has observed that great smokers not unfrequently have irregularity of the pulse.

Quickness (abruptness of beat) is not quite the same thing as *rapidity* of pulsation, although they may occur together. A pulse may be *jerking*, though moderate in rate; or, again, rapid and *thread-like*, as, for example, in great debility.

Fulness or *largeness* of pulse is also to be distinguished from its *strength*. A pulse may be *large* and *soft*; or, on the other hand, small and firm, or wiry.

Palpitation is a felt over-action, or irregularity of action, of the heart. It may proceed from "nervousness," especially in persons of sedentary habits; or it may accompany dyspepsia, from sympathy between the stomach and the heart. Strong coffee will bring it on with many people; very strong tea will do so with a few; tobacco in some, and alcoholic excess in others. Sexual and sensual excess or abuse is a very common cause of it. Palpitation may be *functional* only; that is, not dependent upon any fixed or progressive "organic" disease of the heart. But *continued* or very *often repeated* over-action of the heart is to be regarded as important enough for the exercise of much care, both in diagnosis and in self-management.

We have already intimated that the action of the heart is much affected by the condition of the *brain*. This is shown not only by the changes of the pulse, but also by the character of the *heart-beat*. Indeed, the chief agency in producing the arterial pulse being the heart's contraction, changes in the one must always at-

tend alterations in the other. We feel the pulse at the wrist only because of its convenience; several other arteries are also within reach of the touch;—as at the temple, in the throat (carotids), and behind the inner ankle.

Hemorrhage or *bleeding* not produced by a wound, from whatever part of the body it may come, naturally excites some alarm. It is called *external* when it escapes from a wound or from some natural passage, and *internal* when it flows into some cavity of the body or into the structure of some organ.

Among the first are hemorrhages from the *nose*, which may escape either from the nose or mouth, or from the *mouth*, stomach, throat, or lungs, the blood being spat, vomited, or coughed up. *Bleeding from the ears* may occur from the skull being broken, or from some disease of the ear. *Bleeding from the bowel* is most often dependent upon piles. There are also bloody stools in inflammation of the lower bowel, or dysentery, in typhoid fever, cancer of the bowel, and obstruction of the bowel. *Bloody urine* is less frequent, and is an indication of disease of the urinary organs. [See chapter on the Kidneys in Health and Disease.]

Internal hemorrhages commonly result from a diseased state of the blood-vessels. The two varieties most evident to the non-professional person are those which occur in the skin in the diseases called purpura hemorrhagica, or "the purples," and in scurvy, in which cases it leads to spots of greater or lesser size, which are liable to be mistaken for bruises.

Some persons are born with a peculiar disposition to bleed excessively from even the most trivial injuries of the surface; in which cases it is found that there is a want of the element of the blood called fibrin, the office of which is, by the formation of a clot, to arrest bleeding. The Index will refer to other portions of the work where the subject is considered more in detail.

Symptoms Affecting the Breathing Organs.

Difficulty of breathing occurs under a variety of circumstances. In croup, the entrance of air is obstructed high up in the windpipe. In asthma, the impediment is in the smaller subdivisions of the air-tubes, near the lungs. Pneumonia is attended by the filling up of the substance of the inflamed lung with blood or lymph, and, to the same extent, excluding air from it. In pleurisy, adhesion, more or less extensive, of the pleura around the lung, prevents the latter from expanding in breathing, and makes every breath acutely painful. Severe bronchitis, at least in its early stage, has oppression of breathing, with soreness of the lower windpipe, as

a common symptom. In pulmonary consumption, shortness of breath is usual, increasing more and more as the malady advances. Persons suffering with heart-disease also often suffer with difficulty of breathing, especially upon exertion. Another cause of the same symptom is dropsy of the chest (hydrothorax), and abdominal dropsy, when the amount of water accumulated is large, sometimes rendering it nearly impossible for the patient to breathe except while sitting up.

The *rate* of breathing, in a healthy adult, is about sixteen or eighteen times a minute. In fever, and in many other morbid conditions, the breathing is much hurried. It is, on the contrary, slow, deep, and snoring, in stupor, as from apoplexy, opium poisoning, dead drunkenness, or fracture of the skull with compression of the brain.

Pain in the chest is, as already said, very sharp in pleurisy. It is dull in bronchitis and pneumonia; more intense, with a sense of distress, in acute inflammation of the heart (endocarditis and pericarditis). Not unfrequently, a burning pain in the breast (heart-burn) is caused by disorder of the stomach. Aneurism (local enlargement) of the aorta also gives a sense of oppression, often attended by pain. Rheumatism of the chest (intercostal, between the ribs), neuralgia (nerve-pain) of the chest, occurs sometimes with severity. Neuralgic pain is the more severe; that which is called rheumatic involves the muscles and ligaments, and is increased by muscular action, as in breathing.

Cough is one of the commonest of symptoms. It has several causes and characters. At the beginning of a "cold on the chest," which in the greater number of cases is an attack of bronchitis, the cough is dry and tight. After a while it loosens and is attended by expectoration of mucus; in protracted and bad cases, there is pus, also, or a muco-purulent discharge, greenish or yellowish in appearance.

In pneumonia, the cough is short and somewhat sharp; it is, indeed, not unfrequently almost absent. Pleurisy is not characterized by cough; if it occur, as may be the case especially in pleuro-pneumonia, adhesions are apt to make it extremely painful.

Consumption is often ushered in by a cough, which may be bronchial, or only hacking. Later it deepens more and more, so as to become distressing and wearisome, at night as well as by day. In advanced consumption, copious expectoration occurs, yellow, green, or bloody, with thick roundish dabs of tough matter, which sometimes will sink in water.

Croup is recognized, in the early stage, by a hoarse, barking cough. In the least dangerous form—spasmodic night croup—this

may commence very suddenly, waking the child from sleep. If the attack go on to the condition of membranous croup, after one, two, or three days, the cough grows whistling in sound, from the greater and greater obstruction and narrowing of the orifice of the wind-pipe. In any case of croup, the best of signs, giving good hope of relief, is the softening of the cough, and a mucous rattle which attends it and the breathing.

Whooping-cough is known by the peculiar, violent, spasmodic or paroxysmal attacks of coughing. Often the child (or adult, as it is not quite confined to children) may be free from cough for many hours together, and then it will have a severe and protracted spell, in which it will grow quite "black in the face," and seem as if it might strangle to death. Such a termination to these spells, however, is rare. Abundant mucous, or muco-purulent expectoration, is common in whooping-cough. The *whoop* is not invariably present, being produced by the in-drawing of the breath through the narrowed wind-pipe, after the air has been almost all coughed out of the lungs.

Sympathetic cough is met with occasionally, when the stomach, heart, liver, or nerves of the chest are disordered. Such a cough is apt to be dry and hollow, or hacking. Aneurism of the aorta may produce cough and difficulty of breathing by pressing upon the bronchial tubes and the trunk or branches of the pneumogastric nerve. [See Chapter on Anatomy.]

Hiccough is a symptom connected with spasm of the diaphragm, *i.e.*, the broad muscle which lies beneath the lungs, making the dome-shaped floor of the chest and roof of the abdomen. Hiccough may be brought on by a slight cause—as prolonged laughter, or temporary indigestion. In persons greatly exhausted or prostrated by illness, its occurrence and continuance is an unfavorable sign.

Heavy-smelling breath is usual at the beginning of an attack of fever. Bad teeth and habitual indigestion will, however, make the breath of disagreeable odor at any time.

Symptoms Presented by the Tongue, Mouth, Etc.

Because the tongue is in sympathy with the stomach and other "mucous membranes" of the interior of the body, we can, with considerable confidence, infer their condition from its appearances. A *furred* tongue is very common when the stomach is disordered, even temporarily. Fever of any type is almost always accompanied by the presence of fur upon the tongue. In low, prostrate, continued fever, the fur may become *brown*, or *blackish*, and the

tongue may be *cracked* in different directions. *Dryness* of the tongue is usual in fever. Its becoming moist and clean is always a good sign. *Yellowness* of the tongue attends liver disorder, with a tendency to jaundice. A *bitter taste* is very apt to accompany this condition, especially on rising in the morning. *Sourness* of the mouth occurs in dyspepsia ; *i.e.*, chronic or habitual indigestion. A *strawberry-like* appearance on the upper surface of the tongue is frequently (but not quite exclusively) seen in scarlet fever. *Paleness* of the tongue is common in decided cases of poverty of blood (anæmia). A *cold* tongue, with cold breath, is an almost certain sign of death in cholera.

Palsy affecting the tongue is most often one-sided, so that the patient can push it out of the mouth on one side only, and it goes towards the paralyzed side. In apoplectic cases, however, and in many instances of paralysis, there is great difficulty or impossibility of protruding the tongue at all.

Salivation is an excessive increase of the secretion of saliva. It was once a not uncommon result of the medical use of mercurial medicines, but most physicians now avoid their employment in quantities likely to produce such an effect.

Bleeding of the gums is one of the symptoms of scurvy. In some cases of consumption there is a *red* line along the edge of the gums ; and a *blue* line in many instances of poisoning with lead, as in painter's colic, or in salivation from the poisonous action of mercury.

Difficulty of swallowing, when not caused by a hare-lip of considerable extent, or absence of the roof of the mouth—by which means it becomes difficult or impossible to suck food or drink into the back part of the mouth—may be caused by a swollen condition of the tonsils, soreness of the upper part of the throat as in an ordinary cold, in croup, quinsy, or diphtheria ; in narrowing of the gullet or œsophagus by disease of its walls, or by pressure against them of an abscess, an aneurism, or some other morbid growth ; or from paralysis of the muscles of the palate and pharynx, such as follows diphtheria and some obscure affections of the base of the brain and upper portion of the spinal cord.

Sickness of Stomach and Vomiting.

Nausea or sickness of stomach often occurs without vomiting, but always tends to be accompanied by the latter symptom. We may, then, speak of this tendency as essentially the same kind of symptom in all cases. Its causes, however, are quite various.

In indigestion, with or without colicky pain, sickness and vom-

iting are very common. Inflammation of the stomach (gastritis) is much more rare; when present, it has, besides nausea, great irritability of the stomach and tenderness on pressure in a marked degree.

Cholera morbus is attended by vomiting and purging together. The same is true of the cholera infantum of young children. In epidemic or malignant (Asiatic) cholera it is more violent and obstinate; with copious discharges like rice-water, cramps of the limbs, oppression in breathing, coldness and great prostration. In bilious remittent fever, and in yellow fever, vomiting is almost always present. The *black vomit* of yellow fever is very characteristic, though it may be absent in mild cases of the disease. Scarlet fever, measles, and small-pox, especially in children, are all very apt to have vomiting as an early symptom. Hysterical vomiting is not uncommon in nervous girls and women. Pregnant women, more often than not, suffer with "morning sickness;" but they do not always vomit with it. In a few cases the symptom is scarcely capable of relief until the child is born. Ulcer and cancer of the stomach are often, but far from always, accompanied by vomiting. Bright's disease of the kidneys, at a rather advanced stage, is also accompanied with this symptom. Sympathetic vomiting is one of the most frequent signs of disease of the brain; as at the onset of hydrocephalus (dropsy of the head) in children.

Obstruction of the bowels, in any form (*e. g.*, strangulated rupture, or *hernia*), is apt to have vomiting as a symptom; sometimes the fæces are ejected from the stomach in these dangerous cases. Poisoning, as by arsenic, tartar emetic, corrosive sublimate, strong acids, caustic alkalies, or any other irritant poisons, produces most distressing and obstinate vomiting; often, also, purging. Narcotic poisons, as opium, etc., do not usually have such an effect, their influence being exerted upon the brain. Tobacco and lobelia cause vomiting, with prostration, in poisonous doses.

Sea-sickness is one of the most intractable of maladies, for which there is mostly but one of two modes of cure—getting to land, or getting accustomed to the movement of the sea. Besides the obstinate vomiting, this sickness is remarkable, in many cases, for the continued torpidity of the bowels, and scantiness of the discharge of urine.

Symptoms Afforded by the Skin.

Heat and *dryness* of the surface of the body are always met with in fever. *Coldness* of the skin, when well marked, is an un-

favorable sign; although, under some circumstances, it may be only temporary. It is an especial characteristic of the collapse of cholera, and of the paroxysms of pernicious or congestive intermittent fever.

Except at late stages, excessive heat of the body is much the most common condition in disease. In severe pneumonia, scarlet fever, typhoid fever, etc., it often rises to 104°, 105° Fahr., and more. The higher the temperature, when over 104°, as a general rule, the greater the danger to life from the attack. One of the first signs of the beginning of convalescence, is the lowering of the heat of the body (as shown by the skin in covered situations) to or towards the standard of health.

Paleness of the face and body generally, with wasting or emaciation, occurs in anæmia and debility. Anæmia sometimes, however, takes place without emaciation. *Sallowness* is present in chronic liver disease, cancer, and other cachectic affections.

Floridity of the countenance, without fever, betokens (when not immediately due to potions of alcohol, or mental excitement) plethora, or a tendency towards congestion of the brain. Flushing of the face is common in all forms of fever. The flush of hectic fever (seen in consumption, and occasionally in other wasting diseases) is peculiar in being of a bright red hue, and limited to the middle of one or both cheeks; the daily febrile attack, morever, being of but a few hours' duration, sometimes hardly lasting more than an hour. In the early stage of apoplexy, redness of the face is generally observed.

A *purple lividity* of the face is seen in typhus and in typhoid fever.

Blueness of the face, with coldness, occurs in cholera, in the worst cases of cholera morbus, in the "blue disease" (cyanosis) of newly-born infants, and in *suffocation* (asphyxia) by strangulation, or arrest of breathing by irrespirable gases in the air.

So, too, a dusky or bluish countenance, with blueness or lividity of the ears and tips of the fingers and toes, may indicate some malformation or disease of the heart, or obstruction to the flow of blood. Some persons who have taken nitrate of silver for a considerable period, as a remedy, have had the skin assume a remarkable bluish color.

Symptoms Affecting the Bowels.

Constipation, or inaction of the bowels, is a very common effect of mere neglect to attend promptly to the call of nature. Indigestion promotes it; most dyspeptics being habitually constipated.

Sedentary habits also favor it. Almost always, the coming on of fever is attended by constipation. In typhoid fever, either this symptom is absent from the beginning, or it is soon succeeded by the diarrhœa which belongs to the course of that disease.

Costiveness, sometimes confounded with constipation, consists in a deficiency in the amount of fæcal matter, leading perhaps to infrequent evacuation of the bowel. In constipation, however, while the bowel is emptied at too long intervals, the *amount* of fæcal matter is not considerably lessened.

Strangulated hernia and other forms of obstruction of the bowels, have extreme constipation as a marked symptom. This dangerous condition does not meet with relief unless the yielding of the impediment, whatever it be, allows the contents of the bowels to be removed naturally or with the aid of injections, etc. Cancer and stricture of the bowel are occasional causes of constipation.

Diarrhœa, or looseness of the bowels, is produced by a great variety of causes. Among these is the sudden impression of cold, or cold and wet; especially when such an impression is made in summer time, or in a warm climate, which predisposes to relaxation and weakness of the stomach and bowels. Indigestible food and certain natural waters, as well as purgative medicines, may bring on diarrhœa. The operation of a single active dose, however, is often followed by constipation.

Typhoid fever, as above remarked, has diarrhœa as a symptom. It is also quite common in advanced consumption. In young infants diarrhœa is particularly common during their teething time, and most of all in warm weather. Cholera infantum, or summer complaint, is chiefly a disease of large cities, in regions in which the temperature, in midsummer, rises as high as 90° or 95° Fahrenheit.

Dysentery is known by the occurrence of frequent, small, bloody passages, with pain, griping, and straining; also, tenderness of the abdomen on pressure or motion, and, in many cases, fever. [Other symptoms relating to the lower bowel may be found in the Chapter on Malformations and Diseases of the Rectum and Anus.]

Urinary Symptoms.

Strangury, or difficult and painful passing of water, is seen in some persons under the influence of a fly blister. In young infants it is a common result of the irritating character of the urine discharged within the first few days of birth, and in older children is sometimes caused by the irritation of worms in the rectum.

Retention of urine, owing to the shortness of the urethra or tube through which urine is discharged from the bladder, occurs far less often in females than in males, in consequence of a stricture of this tube, but many "nervous" women and girls suffer at times from retention of urine in consequence of temporary inability to contract the muscles of the bladder. A far more serious form of paralysis of the bladder-muscles accompanies some diseases of the spinal cord, and will be mentioned in the chapter relating to these diseases. Pressure on the bladder during child-birth causes often a temporary paralysis of it. And in low fevers like typhoid, it is a symptom to be carefully looked for and relieved. Among males retention of urine frequently depends on narrowing of the urethra either by inflammation or by enlargement of the prostate body, or the presence of stone in the bladder and thickening of its walls by chronic inflammation, etc.

Suppression of urine is different from *retention*. In the latter case, the urine is formed and detained in the bladder. In the former *none is secreted* by the kidneys. This is always an extremely serious symptom, occurring sometimes in low fevers, protracted disease of the kidneys, malignant cholera, etc. Uræmia or urinæmia results, the blood becoming poisoned by the retention in it of materials which should pass off with the urine.

Gravel, or concretions of urinary matter, which are sometimes passed, are generally due to causes not very well understood but existing in the blood and acting through the kidneys. Severe pain attends the passage of gravel stones through the *ureters* or tubes connecting the kidneys with the bladder. Similar attacks of violent and continued pain occur from the passage of *gall-stones* along the gall-duct from the gall-bladder, which lies under the liver, to the intestine. In each case the pain is relieved when the calculus reaches the larger cavity, viz., the bladder in the one case, the small intestine in the other.

When urine is passed in *unusual quantity*, the condition is called diabetes. Its character is, however, not natural in such cases, being either too dilute, or containing a variety of sugar corresponding to grape sugar. These and other evidences of urinary derangement—such as acidity, the presence of blood, albumen, pus, bile, coloring-matter, spermatozoa, sediments of various composition, etc.—are all important evidences to a physician of the nature of existing disease, and are elsewhere more fully considered.

Muscular Symptoms.

Weakness is an almost constant attendant of disease of any kind. Entire inability to move a limb may depend upon different causes. There may be anchylosis or solid union of the joints, the muscles still retaining their power; but in most cases total loss of ability to move depends upon disease in the brain, spinal cord, or the nerves leading to the muscles, and, when affecting the face, assumes the form of facial palsy; when, usually, all the muscles on one side of the face are paralyzed, and the mouth is drawn by the acting muscles to the opposite side. Hemiplegia is palsy of the muscles on one side of the body; and paraplegia exists, when the lower half of the body is palsied and its muscles are not under the control of the will. Some diseases lead to palsy of certain groups of muscles; as is the case in the paralysis of infancy, when all, or a portion of the muscles of a single limb, remain powerless: diphtheria, which is often followed for a time by palsy of the muscles of the palate and throat: cerebro-spinal-meningitis, or "spotted fever," when similar palsies occur of limited groups of muscles.

Rheumatism may attack the fibrous coverings of muscles, as well as the joints, and cripple them. Lumbago, in which there is stiffness and lameness of the lower part of the back, is usually of this nature.

Long inaction of any of the muscles will render them feeble, perhaps quite impotent. For instance, after a person has been confined to bed in one position for many weeks during the treatment of a fractured thigh, when the splints are taken off, it is for a while nearly impossible for him to arise and walk. Surgeons have to consider this in the management of fractures of the arm or forearm; providing against stiffness of the fingers, by occasionally moving them in the course of the treatment.

Spasm of muscles may be quite limited to one or a few parts of the body, an example of which is seen in the cramps of limbs which have suffered an arrest of blood-circulation through remaining too long in a constrained position. In lockjaw, on the other hand, the muscles are not at fault, but the spasm is caused by some disturbance in the nervous system which in health regulates the movements of the muscles of the jaw. Spasm may be continuous, as in lockjaw or in tetanus, when the muscles are rigid; or jerking, as in convulsions. Irregular muscular movements take place also in St. Vitus's dance (chorea) and in the shaking palsy of aged people.

Nervous Symptoms.

Pain is the most frequent and familiar of the symptoms affecting the nervous system, giving, in many instances, indications of the seat and nature of the disorder present. Sometimes, however, pain may be located at some distance from the part diseased; as, when indigestion produces "heart-burn," or pain in the breast; or disorder of the liver causes pain under the shoulder blade. Likewise, hip-joint disease is mostly attended by pain in the knee; stone in the bladder, in the male, by pain in the sexual organ; and irritation of the womb, by pain at the top of the head, as well as in the back and lower limbs and below the breast.

Pain in the head may have either, or several at once, of numerous causes. The commonest kind of headache appears to be connected with a slight or moderate degree of fulness of blood in the head (congestion). The pain in such a case is more or less throbbing, and is increased by moving about, or by loud noise or strong light. Neuralgia of the head is known by *sharp* pains on the surface of one side, very often extending to the face. Fever, of any kind, is apt, especially in the early stage, to have headache as a prominent symptom. Muscular rheumatism of the head is not uncommon; in most cases, some of the muscles which move the head on the neck are so involved as to show the nature of the case. Mention has been made already of sympathetic headache, from disease of the womb, or of some other organ. Obstinate, long continued, or periodical pain, in one part of the head, when not neuralgic, may give rise to suspicion of the presence of disease of the brain.

Pain in the chest may be due to rheumatism of the rib muscles, pleurisy, pneumonia, neuralgia, heart-disease, disorder of the stomach, aneurism of the aorta, or cancer of the lung. The last two are comparatively rare affections; especially is this the case with pulmonary cancer.

Pain in the right side, along or near the edge of the ribs, especially if there be also pain under the right shoulder-blade, is probably connected with the liver. Deep-seated pain, on either side of the spine, yet not in the back-bone or the muscles, points to disorder of the kidneys. Symptoms affecting the discharge of urine will confirm this suspicion.

Abdominal pain is, in the majority of instances, colic, from flatulent distention or spasmodic contraction, either of the stomach or of a portion of the bowels. Lead colic is accompanied by a shrinking and hardening of the bowels; ordinary flatulent (and

the more severe and continued form called bilious) colic, by windy distention. Colicky pain is apt to change place somewhat from time to time. A fixed pain in the bowels, with tenderness on pressure, should cause suspicion of intestinal inflammation—a very serious affection.

Pain over the entire belly with tenderness even upon slight pressure, and increase of pain upon moving the legs, are among the signs of peritonitis, or inflammation of the thin membrane lining the abdominal cavity and covering its contents.

Another more uncommon cause of abdominal pain, is cancer of the stomach or intestine. Aneurism of the abdominal aorta (the main trunk artery of the body) is also commonly, though not invariably, attended by pain. The tumor, in this instance, is *pulsating* to the touch; sometimes, with a large aneurism, there is even a visible throbbing. Now and then, however, a moderate throbbing of the aorta near the stomach or liver may be felt, in dyspepsia, without any aneurism.

Spinal disease not unfrequently has pain in the belly as one of its symptoms; its nature is then to be ascertained by other special characteristics. Abscess ("psoas abscess") in the lower part of the belly is a possible but not common occurrence. Severe suffering is produced by the passage of a gall-stone along the gall-duct, and also by the passage of a gravel along one of the ureters from the kidney to the bladder. Other causes of abdominal pain might be named, but they are rare compared with those which have now been mentioned. Neuralgia may affect the abdomen, as well as the head, chest, or either of the extremities; in fact, any part of the body. Tenderness on pressure at the place of the pain, is frequently present in neuralgic cases; but it is a *local, superficial* tenderness, and not accompanied by the other signs of inflammation, unless it be that of the roots or sheath of the nerve which is the seat of pain.

For an account of painful affections of the abdominal organs peculiar to women, reference may be made to that portion of this work devoted to Diseases of Females.

Opposite to pain is *loss of sensation*, local or general. *Anæsthesia* is a technical term for loss of the sense of touch; *analgesia* means loss of capacity for feeling pain; hence ether, chloroform, etc., used to assuage the pain of labor, or of operations, are called anæsthetics (although *analgetics* would be a more proper term). Palsy (paralysis) is generally marked by loss of sensation as well as of power in the limb or other part involved.

Derangement of the intellectual faculties takes place to a greater or lesser degree in fever, and in nearly all diseases by which the

general nutrition of the body is affected. Congestion of the brain, or a lack of blood-supply, may equally produce it, and the presence in the blood of certain poisons is another cause of delirium or stupor, more or less profound. A fourth cause of mental derangement is a shock to the brain substance, either from a blow or from a very intense mental impression, such as powerfully affects the emotions.

Symptoms Afforded by the Eyes and Ears.

The eyes may manifest diseases of their own structure, which are the subjects of special study, treated of in another part of this work; or they may indicate, symptomatically, morbid conditions of the brain. *Rolling* the eyes from side to side is a common symptom of brain trouble, especially in infants. Before the beginning of a convulsion, not infrequently the eyelids are rapidly closed and opened a number of times. *Squinting*, when not habitual during health, is, in the presence of other evidence of brain disease, a bad, though not necessarily, a fatal symptom. The condition of the *pupil* is often significant. It is usually dilated in apoplexy, dropsy of the head, and poisoning by Jamestown weed (stramonium); and *contracted* in stupefaction by opium, as well as in inflammation of the interior of the eye, or of the brain. *Shrinking from the light* is a sign either of inflammation of the eye or brain, or of an unusual morbid condition of the nervous apparatus.

Deafness (to be specially considered in another part of this work) may result, in various degrees, from wax accumulated in the ear; from structural disease of the external, middle, or internal ear; from very large doses of quinine; from typhus or typhoid fever, or from serious disease of the brain.

PHYSICAL DIAGNOSIS.

Thus far, we have considered chiefly those indications of disease which are obvious, or which are made known by the patient's own account of himself. Other manifestations of morbid changes in the internal organs, especially in the lungs and heart, are recognized by processes requiring special knowledge and skill. The principles, nevertheless, of these processes, are very simple. The eye, the ear, and the hand, are employed to ascertain what differences exist in the physical conditions of the contents of the chest or abdomen, from the conditions known to belong to health.

Besides *inspection* by the eye, of the shape and size of the two sides of the chest, or of the contour of the abdomen, careful *measurement* of the dimensions of those parts of the body, sometimes

made daily, or at longer intervals, may render important service. Pleuritic effusion (dropsy of the chest, from inflammation) upon one side may thus be revealed; or, if instead of distention, there be contraction of one side, the disappearance of watery effusion may be inferred in some cases, and collapse of the lung from disease in others. Inspection of the abdomen assists greatly, of course, in the discovery of pregnancy, and ovarian and other tumors.

By the *touch*, skilfully used, a practitioner may learn a good deal about the state of the contents of the abdomen, as well as in regard to the character of morbid swellings in other parts of the body. Hardness, softness, mobility, and fluid fluctuation, are thus especially determined.

Percussion is the term applied to a method of tapping or thrumming with a finger, or with a little hammer made for the purpose (most physicians use the finger), either directly upon the chest or abdomen, or on a finger laid upon the part examined. Occasion-

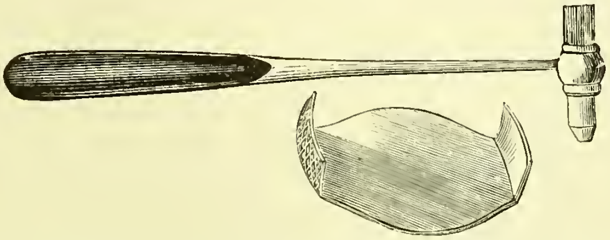


FIGURE 175.—A hammer with an india-rubber head for percussing, and an ivory or hard rubber shield, called a pleximeter, which is to be laid upon the surface of the part examined to receive the blows of the hammer.

ally something else is used to percuss upon instead of the finger. Generally, the middle finger of the left hand is placed at length over the part, and the fore or middle finger of the right hand is used to *thrum* gently upon it. The sound thus brought out is often very significant. Masons and others employ the same method to ascertain whether a wall is of brick or of frame-work, or to find the position of a hollow flue in a solid wall, etc., etc.

When, for an illustration, the lungs are perfectly healthy, tapping anywhere on the chest, except just over the heart, or near the liver, or on the thickest part of the shoulder-blade, will bring out a hollow sound. Striking, instead, on the fleshy part of the thigh, will produce a very dull, scarcely audible sound. Over the belly, when distended with wind in the bowels, a "drum-like" (tympanitic) resonance will be obtained. These last, the drum-like and the thigh sounds on percussion, are extreme opposites, between which other kinds of resonance may be ranged, differing

mainly in degree. Some peculiar sounds, however, are at times noticed, as the "cracked-pot" sound, in certain cases of advanced disease of the lungs.

If *air* fills the lungs, as in full health, the hollow sound, above mentioned, occurs. When, instead, *water* (as in pleurisy, with effusion) fills up part of the chest, a dull sound is produced. So it is, in greater or less degree, when a lung is *solidified*, in pneumonia, or in consumption. Not unfrequently, however, destructive change in a lung from consumption may leave a cavity or a collapse of a portion of the lung-tissue, and then the "tympanitic" sound results; or one not very different, called "amphoric."

Over the heart, which lies behind the breast-bone and the third, fourth, and fifth ribs, just to the left of the breast-bone or sternum, the percussion resonance is moderately dull; although far from having the flatness of the thigh sound. Along and just above the lower edge of the ribs on the right side, the liver gives another region of moderately dull sound. When the stomach is empty, a somewhat peculiar hollow sound belongs over it—changed to a dull sound immediately after a meal.

Percussion over the abdomen often affords very important signs; as, for instance, discriminating between windy distention of the belly, giving a very hollow (tympanitic) sound, and dropsy of the abdomen, with the dull resonance produced by accumulation of water. Tumors, aneurism, etc., will also cause dulness of abdominal resonance; the limits of which will assist very materially in locating precisely the seat of disease, and in inferring its character.

Auscultation is simply careful *listening* to sounds occurring in the cavities of the body. Except in the case of pregnancy not much opportunity occurs for diagnosis by auscultation of the abdomen. Affections of the chest are so constantly examined by auscultation and percussion, that a skilful practitioner, at the present time, would as soon omit feeling the pulse as listening to the sounds of the chest in any case involving the lungs, heart, or pleura.

Instrumental auscultation is effected by the use of a single or double tube, called a *stethoscope*. Its chief advantage is found in distinctly locating sounds in the region of the heart. For listening to the lung-sounds, many practitioners prefer to place the ear directly upon the chest, proper care being taken to protect the patient from exposure to cold during such an examination.

The same simple principles lie behind diagnosis by auscultation as have been mentioned in connection with percussion. We must ascertain first, what sounds are heard upon listening with the ear

over healthy lungs, or over a healthy heart. Then we can compare, with these as "normal" or standard sounds, those heard in different cases of disease. No one can become skilful in practical auscultation without actual familiarity both with healthy sounds and with those met with in the various disorders of the lungs and heart. Except in hospitals, a long time may elapse in the experience of a practitioner before he meets with nearly all the characteristic morbid sounds whose meaning has been ascertained. Here we find one of the important reasons for the use of hospital wards for "clinical" or bed-side instruction of those who are preparing for the responsibilities of medical practice.

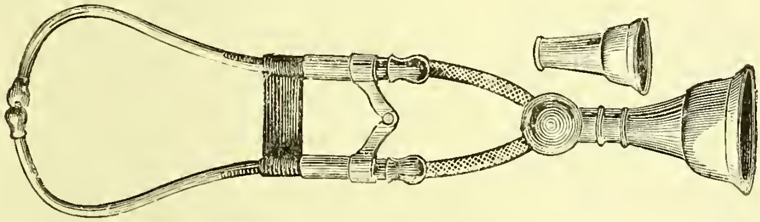


FIGURE 176.—A "Camman" Stethoscope. The tips of the curved tubes being placed in the ears, are held in place by an elastic band, the trumpet-shaped extremity is then applied over the seat of the sound to be listened to.

To describe all these morbid sounds and their interpretation would be appropriate only in a technical medical work. For the unprofessional reader, it will be proper to mention here only, very briefly, some of the more strongly marked auscultatory signs so as to illustrate the use of this method of diagnosis.

A *soft breathing sound* (vesicular murmur) is heard over the chest when the lungs are healthy. In a child (except when asleep or very quiet) this sound is louder and more blowing than in the adult. Child-like or "puerile" respiratory sound, therefore, is a term sometimes applied to a slightly blowing sound in a grown person from incipient disease.

Suppose a case of pneumonia or inflammation of the lungs. In the early stage for a day or two, besides moderate dulness of resonance on percussion over some part of one side of the chest, on listening there we will find, in place of the natural soft breathing murmur, a *fine crackle*, much like what is heard when one rubs a few hairs together between a thumb and finger close to the ear. This is the "crepitant râle" of pneumonia. After two or three days, instead of this we will hear a *blowing* sound of respiration. Still later, should the case advance unfavorably, there will occur a *coarse* crepitation, accompanying the breaking down of the matter which has been deposited. If, on the other hand, the inflam-

mation gives way early, as resolution takes place, the blowing sound disappears, and the fine crepitating sound comes back for a few days longer, to be succeeded again by the normal murmur of health.

Take, as another example, the progress of an ordinary case of pulmonary consumption. First of all (in *most*, not all cases), on auscultation, we will find, just below the collar bone on the left side, the *expiratory* sound to be longer and somewhat more blowing than is natural during perfect health. Next to this, after a variable interval of weeks or months, it may be, a *blowing* respiratory sound follows, much like that of the middle stage of pneumonia. Later still, as the lungs undergo serious degeneration, first a dry crackling, and then a moist gurgling will be heard; along with, or else substituted by, other sounds, which indicate cavities in the lungs, collapse of a lung, pleuritic effusion, etc., etc. For an account of these in particular, we must refer to professional works.

Pleurisy will answer for a third illustration of the use of physical signs in diagnosis. The inflammatory adhesion of portions of the pleural membrane, which causes the *stitch* in breathing, also produces a to-and-fro *friction-sound* which is heard on listening carefully over the affected side. Afterwards, when watery effusion within the pleural cavity has occurred, this compresses the lung, solidifying it, so as to cause the *blowing* sound of breathing when listened to near the effusion. This blowing sound, in any case, is called *bronchial respiration,* because it resembles the sound heard when the ear is placed right over the bronchial region, where the wind-pipe divides to send its branches (bronchi) to the lungs. But, if the quantity of water effused becomes great, breathing in that lung may be suppressed; no respiratory murmur is then heard, and the resonance on percussion is very dull. A notable fact in connection with pleuritic effusion is, that the region of percussion-dulness changes with the position of the body; falling when the patient lies on the back, and rising to a higher line when he is sitting or standing upright. When the effused fluid disappears by absorption, or is drawn off by an operation, that side of the chest becomes more or less contracted and depressed; the compressed lung is, however, released, and its breathing is then gradually resumed, with blowing or bronchial respiration again for a time, and at last the normal sound.

Bronchitis is the term for an ordinary severe "cold on the chest," with cough. In this affection, the characteristic sounds heard on auscultation are *mucous* sounds, called *sonorous* and *sibilant* (hissing, whistling). They vary considerably, according to

the amount of mucus (phlegm) in the bronchial tubes, even within a few minutes, in different parts of the chest.

Vocal sounds are compared, also, with those recognized in health, by listening with the ear upon the chest while the patient speaks aloud. Important and significant differences are thus often obtained in various diseases.

Diseases of the heart are subject to physical examination, with almost as much precision of diagnosis as those of the lungs. *Palpation, i. e.*, the careful use of touch, serves an excellent purpose in determining the rate and character of the heart's beat, the force of which is called its impulse. *Percussion* in some cases will detect extension of the dulness of resonance over the region of the heart beyond its usual limits. This may be the result either of enlargement of the heart, or of effusion of fluid within the pericardial sac by which the heart is enveloped.

Auscultation of the heart examines chiefly, though not exclusively, its two sounds: the first and second. The first sound is longer and louder than the second and accompanies the main beat or contraction of the ventricles of the heart, which causes the impulse. The second sound attends upon the closing of the arterial valves of the heart, during the dilatation of the ventricles.

Frequently, from disease of the lining membrane of the heart, some of the valves are altered and injured. Most generally it is either the *mitral* or the *aortic* valves (both belonging to the *left* side of the heart) that are thus affected. Either valve may be, from structural alteration, imperfectly closed, or insufficiently opened, or both. Such changes are detected by alterations in the first and second sounds, above-mentioned.

Aneurism of the aorta is made known especially by the existence of another impulse, apart from the heart, but keeping time with it. Other signs of this affection exist also, not needing description in this place.

SPECIAL INSTRUMENTS FOR DIAGNOSIS.

A very brief allusion to these may here be made. Those of most importance are the following: 1. The clinical thermometer; 2. The ophthalmoscope; 3. The laryngoscope; 4. The otoscope; 5. The sphygmograph; 6. The urethral endoscope; 7. The vaginal speculum; 8. The uterine sound; 9. The pneumatic aspirator; 10. The microscope; 11. The dynamometer; 12. The spirometer; 13. The æsthesiometer.

The *clinical thermometer* is merely a small thermometer so shaped as to be conveniently introduced into the arm-pit, under

the tongue, or into the lower bowel, for observation of the bodily temperature. It should be retained in its place for nearly five minutes before the height of the mercury in the tube is noted.

FIGURE 177.—Clinical Thermometer. The dark line between the graduations 100 and 105 is a detached portion of mercury which is left behind as the column of quicksilver contracts by cooling, and its upper end indicates the height to which the mercury has risen.

A very low arm-pit temperature, *e. g.*, below 90°, is a sign of immediately dangerous prostration. A very high temperature, 106° to 108°, is almost as alarming, in view of the impending progress and consequences of the attack. Certain diseases, as typhoid fever, relapsing fever, etc., have a more or less regular succession of temperature changes. Both for *diagnosis* and *prognosis*, then, *i. e.*, to determine *what is the matter* and *what will be the result* of the disorder present, careful observation, and often record, of the indications of the thermometer, from time to time, will be of much importance. [The value of this means of diagnosis when the thermometer is in the hands of an intelligent person and can be used frequently and without delay, has led to the introduction elsewhere of a special section devoted to it.—ED.]

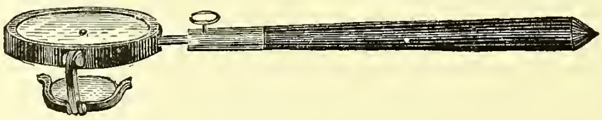


FIGURE 178.—Ophthalmoscope.

The *ophthalmoscope* is a specially constructed perforated mirror for the close examination of the interior of the eye by a strong light. It is principally employed in the treatment of affections of the eye itself; although not unfrequently used, also, to learn something indirectly concerning the condition of the brain. [See Chapter on Diseases of the Eye, in this work.]

The *otoscope*, or ear-speculum, is a small tube designed for close inspection of the accessible portion of the ear. [See Chapter on Diseases of the Ear.]

For an account of the urethral *endoscope*, we must refer the reader to what is said in more technical treatises on Diseases of the Male and Female Genital Organs. All that is needed of information in regard to the *vaginal speculum* and *uterine sound*, will be found under the heading of Diseases of Females.

The *laryngoscope* is a small mirror, fixed on the bent end of a

handle, and used to throw light upon the entrance to, and upper portion of the larynx or windpipe. The mirror is commonly not more than an inch in diameter. It is introduced gently through

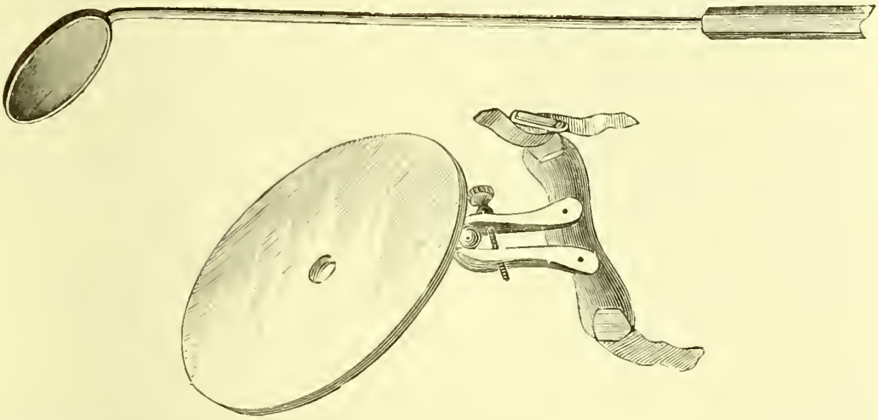


FIGURE 179.—Laryngoscope and Reflector. The latter is attached by an elastic band to the forehead of the examiner, and serves to reflect the light from a lamp into the cavity of the mouth.

the open mouth, so as to rest against the upper palate, sloping over the entrance to the windpipe. A strong light being then directed upon it by another larger mirror, the observer can look right into the larynx. Thus the vocal cords can be seen, and the physiology of the voice has been studied to advantage with this instrument. The condition of the larynx as to health or disease can, by its aid, be thoroughly examined: and surgical operations, for removal of laryngeal tumors, etc., are thus often greatly facilitated. [See Chapter on Diseases of the Throat.]

The *rhinoscope* is a still smaller mirror, arranged upon the same principle, to inspect the condition of the passages from the posterior portions of the cavities of the nose downward towards the throat.

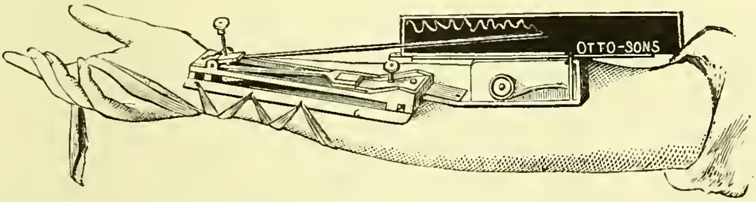


FIGURE 180.—A Sphygmograph in position.

The *sphygmograph* is an extremely ingenious instrument, contrived not only for precisely measuring, but also for recording the pulse. Its essential parts are, a delicate lever, one end of which

rests firmly upon the artery which pulsates at the wrist, while the other end carries a sort of pen ; and a recording apparatus, which, by clock-work, so moves a strip of paper as to receive a tracing of the pulse-beats from the pen at the end of the lever. Thus all the characters of the pulse, in health and disease, can be made visible for careful study and comparison.

The sphygmograph is of great value in the study of the causation of the pulse, as a physiological subject; and also in the investigation of diseases of the heart and blood-vessels. For the purpose of the practitioner, however, unless in hospitals, it cannot be conveniently employed to any great extent.

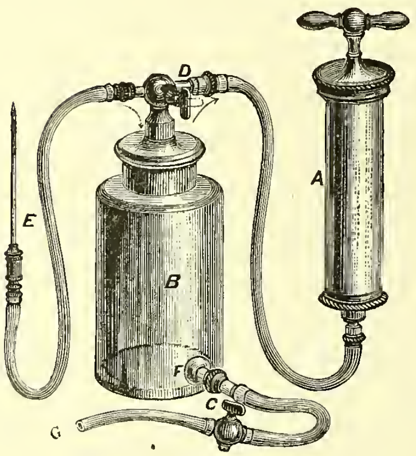


FIG 181.

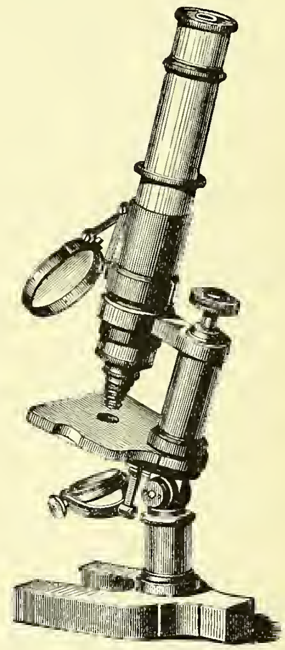


FIG. 182.

FIGURE 181.—A Pneumatic Aspirator. A, is a pump used for exhausting the air from the vessel B. D, is a two-way stop-cock, opening either in the direction of the pump or to the hollow needle E. F, is an outlet in the bottom of the bottle, closed by the stop-cock C, by which the bottle may be emptied when necessary, in the course of an operation.
FIGURE 182.—A common form of Microscope.

Pneumatic aspiration is effected, both for diagnosis and for the treatment of fluid accumulations, by means of an exhausting instrument, with which is connected a fine hollow needle. This needle is so small, that it can be introduced almost anywhere into the body without much danger; and yet the suction apparatus to which it is attached makes it a potent and often very useful instrument in cases difficult to deal with otherwise. By drawing out a

drop or two of fluid from a swelling whose nature is not clearly known by other signs, its examination may be satisfactorily made. Whether or not to operate further in such a case, may thus be decided. Large quantities of fluid may, when desirable, be withdrawn from the cavities of the body by means of the aspirator.

The *microscope* is one of the most magnificent contributions of physical science to human knowledge. Its sphere may almost be said to be the whole accessible world. Its services in connection with the study of disease are very numerous. Both in practical medicine and in surgery, its minute inspection of the fluids and solid tissues is often invaluable for diagnosis, and thus for treatment. After death, the information which it reveals in regard to the changes produced in the organs by different diseases, goes

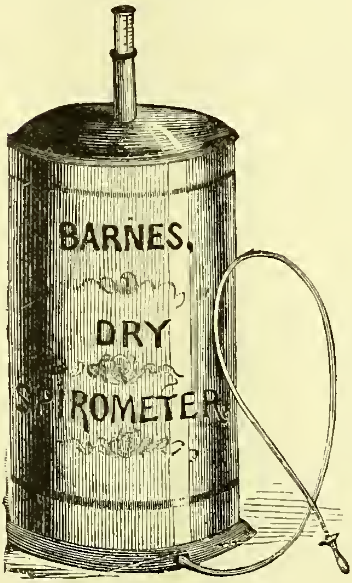


Fig. 183.—A Spirometer.

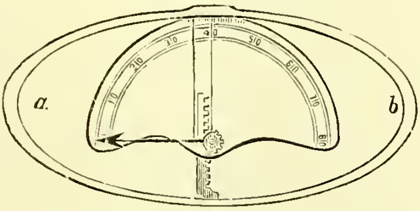


Fig. 184.—A Dynamometer.

farther, and is more exact than that obtainable by any other method. Not the least of the utilities of the microscope is that belonging to the aid it gives in medical jurisprudence, in determining the nature of materials (as blood, etc.) in weighing evidence in criminal trials.

The *Spirometer* is used to measure the air-capacity of the chest, and consists of an air-receiver into which the person blows after first filling the lungs by a forcible inspiration. In the variety here shown, the rod projecting from the top has an index of the number of cubic inches of air expired.

The *Dynamometer* consists of an elliptic spring used to deter-

mine the relative strength of the grasp of the hands compared with each other and with the healthy condition; and also, in some cases, the power of maintaining steady and uniform contraction of the muscles of the fore-arm and hand. An index serves to show the degree of force exerted.

The *Æsthesiometer* is used to determine the acuteness of the sense of touch, which varies at different parts of the surface and undergoes considerable changes in the course of some diseases of the nervous system. There are a variety of modifications of the instrument, but all have two points so arranged that they can be adjusted at different distances. The person being examined closes the eyes, and judges, by the sense of touch, whether one or two

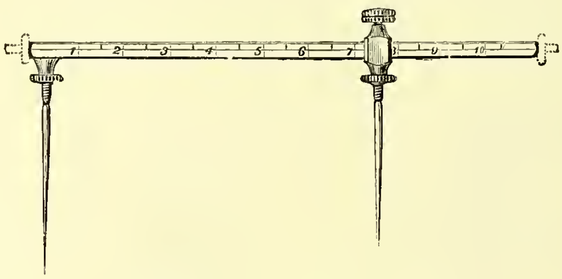


FIGURE 185.—An Æsthesiometer.

points are distinguishable, and the relative acuteness of the sense is an indication of its condition.

Every well-educated physician (and no physician should be otherwise than well educated) needs to be familiar with the above instrumental means which are now employed for the investigation and treatment of disease. Yet we have the best authority for affirming that no apparatus will enable a practitioner ever to dispense with the careful and skilful use of his own natural senses; of his cultivated perception, sagacity, trained judgment and acquired knowledge. Of all the gifts available in the treatment of disease, apart from rare and peculiar genius, the best must always be, *educated common-sense.*

HENRY HARTSHORNE, M.D.

Therapeutics; or, the Modes of Employing Remedies.

BY

RICHARD J. DUNGLISON, A.M., M.D.,

OF PHILADELPHIA, PA.

THERAPEUTICS; OR, THE MODES OF EMPLOYING REMEDIES.

THERAPEUTICS (from the Greek word θεραπεύω, "I alleviate," "I attend upon the sick"), is that department of medical science which embraces the general principles of the management and treatment of disease. A detailed description of the properties of drugs and other remedial agents is more appropriately included under *Materia Medica.* The two branches of study are usually taught in association, but I shall separate, as far as possible, the principles of treatment from the description of the properties of the articles employed. It may seem to the inexperienced that nothing is easier than to prescribe an article of the materia medica in the full hope and belief that certain inevitable good results may follow; but, as will be presently shown, there are many modifying circumstances to be taken into consideration in the proper appreciation of the adaptability of drugs to special unnatural conditions. In other words, the prescriber should be a good *therapeutist.* He must understand the properties of the drugs he wishes to use; must possess the power of accurately distinguishing different states of disease; must appreciate the healing-power of nature, which instinctively tends to the reparation of injuries or the establishment of the usual equilibrium of all the functions; and must comprehend that in the treatment of disease a blind reliance on drugs should not supersede the employment of appropriate diet, and of such general hygienic care as will materially assist, if not frequently procure, the recovery of the patient.

THE CIRCUMSTANCES WHICH MODIFY THE ACTION OF MEDICINES.

are numerous, and must influence the physician in the treatment of each case under his immediate observation. Among these may be mentioned sex, climate, age, occupation, etc., and each of these will be briefly considered.

1. *Age.*—The treatment of tender infancy necessarily varies

greatly from that adopted in adult life. It is not the mere question of difference of age, but rather the difference of susceptibility, the special characteristics of development, the predominance of certain tendencies to disease, that must all be taken into careful consideration. In the earliest period of life, for example, there exists a marked impressibility of the nervous system and of the mucous membranes and skin, leading to convulsive and other nervous affections, diarrhœa, bronchial disturbance, sore mouth, eruptions of various degrees and character, etc. The generally acid condition of the stomach, which may be due to the increased secretion of acid in that organ, or to changes which the food undergoes there, must also be borne in mind. Blisters must also be employed with great caution in infancy, on account of their tendency, if long applied, to produce gangrene.

After this period, these tendencies gradually subside, and not until the period of puberty is there any special condition of the system worthy of observation. From this time, even until after the age of full growth and manhood, there is a greater disposition to affections of the lungs, especially consumption. In old age, owing chiefly to exhausted nervous power, morbid conditions of a different nature, particularly those of the urinary organs, torpor of the intestines, and various forms of chronic disease, almost inevitably occur.

Appreciating all these peculiarities and morbid tendencies, depending on the age and development of the patient, the intelligent prescriber will be able to modify the details of his treatment to suit the particular case.

The *dose* to be administered will vary with the age. The period of adult life is always taken as the standard, and when a dose is mentioned it must always be assumed that this is the age implied.

[Although a number of rules have been suggested by physicians for determining the size of doses for various ages, they are subject to many exceptions, and, owing to the variable strength of most preparations, are of little practical value, since the effect produced by the remedy is the only reliable gauge to the amount which will be required. As an indication of the proportions commonly found to exist, it may be stated that a child one year of age requires one-twelfth the full dose ; two years of age, one-eighth the full dose ; three years of age, one-sixth the full dose ; six years of age, one-fourth the full dose ; eight years of age, one-third the full dose ; twelve years of age, one-half the full dose ; sixteen years of age, three-fourths the full dose.—Ed.]

But there are few rules without exceptions, and such exist here, for some harmless medicines may be given to young children in

large doses, while other more powerful remedies, such as opium, antimony, etc., must be cautiously prescribed in minute doses, if prescribed at all. At this early period it is much more difficult to produce salivation from the use of mercurials than in after-life.

In advanced age, while the doses of remedies are usually those of adult life, there are certain irritating and sedative articles of the materia medica which cannot be administered in the accustomed doses of that period.

2. *Sex.*—Although, as a general rule, the doses of remedies and the treatment of diseases are the same, whether the patient be of the male or female sex, the modifying influence of greater nervous impressibility in the latter may render a diminished dose more judicious, while her peculiar uterine organization may bring into question other elements, giving a new phase to the therapeutic consideration of her case.

Many powerful remedies are quite inadmissible during the condition of pregnancy, as they may endanger the vitality of the unborn child by impairing its nutrition, or by exciting unduly the contractile powers of the uterus. During the time of nursing, similar care and caution must be observed, so that the remedial agents thus introduced into the system of the mother may not, by the active process of absorption, come within the reach of the child at the breast by constituting an ingredient of the milk imbibed by it.

3. *Climate.*—The therapeutic action of medicines is materially affected by climate, for it has been found that it is impracticable to administer the same doses in hot climates as in those of a more temperate character, probably on account of the increased nervous susceptibility of residents of the former. The effect of change of climate upon human health and as an auxiliary to the treatment of disease is an extremely interesting and valuable study. [Many diseases which have their origin in local causes are only relievable when the patient can be removed to a climate where such causes do not exist, in which case it is not so much the direct value of the special resort as the absence of these certain direct causes. In other cases, however, the bracing influence of high mountainous regions, or the relaxing effects of warm, moist, and equable atmospheres, such as exist on our southern sea-coast, are powerful aids in the treatment of many affections, and are fully referred to in another portion of this work.—Ed.]

4. *Occupation and Habit.*—It will be readily understood that these exert a decided influence in modifying the effect of medicines. Those who by their employment are daily exposed to the various changes of temperature and to every phase of weather, become

in consequence less impressible. While they are not, therefore, so liable to attacks of disease, they require larger doses of medicines than those of more sensitive organization whose lives have been cast in luxurious ease and inactivity.

So far as *habit* influences the action of medicines, it may be stated that, as a general rule, the effect is weakened with the protracted use of any agent. In other words, the patient becomes accustomed to the continuous impression of the same dose, and requires an increased amount to produce the same effect, whether the article employed be a stimulant or a narcotic. Yet such is not always the case, as is illustrated in the use of some purgative medicines, saline waters for example, which act more satisfactorily by the repeated daily impression of the same small doses.

5. *Mental Influence.*—Emotional causes also modify the action of remedies ; a large dose, as of opium, being required when the patient is the subject of great pain or mental excitement. It is no new theme for discussion as to the effect exerted by confidence or faith in the treatment, and this is but another illustration of the effect of the mind upon the body. Bread-pills have often been prescribed in cases which required no further medication, merely to gratify the patient with the delusion that he was being subjected to therapeutic treatment.

6. *Temperament and Peculiarities.*—Temperament has much to do with the therapeutic action of medicines. A mode of treatment —blood-letting, for example—that would be tolerated by those of sanguineous temperament, might seriously disagree with those of an opposite or nervous character; while a narcotic like opium would impress the former less favorably than the latter. A dose of a cathartic which would produce gentle purgation in one, might in another prove irritating by its excessive action. Certain medicines always disagree with some individuals, producing violent, almost dangerous symptoms, even when given in ordinarily harmless doses. Some persons cannot even inhale the odor of special drugs without distress, and life is sometimes endangered by a persistence in the use of articles of a comparatively innocuous character. When such is found to be the case, a physician governs his treatment accordingly, and omits the employment of such deleterious or offensive remedies.

In addition to all these modifying influences, other agencies operate to increase the efficiency of medicines, such as the nature and stage of the disease, the purity of the articles employed, the period of the day, and other interfering causes that need not now be enumerated, since they can be correctly appreciated only by one who has specially studied the subject.

It might naturally be inquired *how the medical properties of the various articles employed were first discovered.* It would not be safe to assume that because several substances may possess similar physical or botanical characteristics, their action and medical qualities should be analogous. This is frequently the case, but some of the most virulent remedies may and do exist in the same botanical list with others that are perfectly innocent ; while medicines of very similar therapeutic action are found in very different botanical classes. Although many of the acids and alkalies have among themselves the same general action, merely chemical similarity of composition gives no clue to their remedial virtues. Nothing can be inferred from such physical properties as taste, smell, color, or external appearance. A number of the most commonly employed articles have the same absolutely white color, and are almost indistinguishable except by the application of appropriate chemical tests, and yet they vary in therapeutic action from the most harmless to the most poisonous characteristics. The remedial properties of many of the articles commonly employed were discovered from experiments on the lower animals, the inference being drawn that similar effects would be produced upon the human system. The objection to placing too much reliance on this method is the want of analogy in their physiological and anatomical organization. Some animals will tolerate very large doses of medicine which have a most injurious effect on man ; such active and poisonous articles as tartar-emetic, belladonna, etc., having been taken by them without any apparent evil effect. Sometimes articles are injected into the blood-vessels of animals with the view of studying their effects through the medium of the circulation, but this is not always a safe procedure, and the general disturbance produced in the nervous system is often sufficient to deprive the experiments of value. It is desirable, in investigating the action of medicines, in the living subject, that their influence shall be studied in a condition of disease as well as of health, as the former may modify the potency or efficiency of the agent employed. The modern therapeutist does not confine himself to the study of the therapeutic action of drugs alone. Equally important, probably more deserving of his study, is the investigation of their physiological action, or the evidences exhibited of changes or modifications in the character or functions of organs, by which vital action is increased, diminished, or altered.

Parts to which Medicines are Applied.

It is generally assumed, in the popular mind, that medicines must be given by the stomach, in order to produce their anticipated effects. Other channels are, however, offered for their introduction. Externally, the skin, although naturally an impediment to the rapid absorption of medicines, may be a medium for the therapeutic employment of medical agents. Poultices, lotions, baths, plasters, etc., exert their effect by direct application to this external covering of the body. Friction is also employed in some cases, either dry or with medical agents, usually of a stimulating character ; or a remedy susceptible of solution in some fatty substance may be rubbed into the skin, a delicate portion of the surface being selected for the purpose, at which the entrance of the finely divided article through the pores of the skin may be readily effected. Such regions are also chosen as are most largely supplied with lymphatic or absorbent vessels. The parts selected are usually the inner surfaces of the thigh or the arm, the arm-pit, the back, etc., and the dose to be administered is, of course, larger than that usually given by the stomach. The process is rather tedious and troublesome, and the results often uncertain, while at the same time producing occasionally much local irritation. But when the stomach is extraordinarily sensitive, or difficulty exists in swallowing, this offers an additional channel for the introduction of remedial agents.

Medicines may be introduced through the surface of the skin after removal of the cuticle, or outer layer, by a blister, when they may either be sprinkled upon the bare surface in fine powder, or, if too irritating, associated with some bland article, as lard, simple cerate, etc. The advantages of such a method of administration are, that the article employed acts rapidly and efficaciously without being compelled to pass through an intermediate process of stomachal digestion ; but the application is frequently attended with much pain and local irritation, at times resulting in disfigurement of the denuded part. The articles introduced in this way are usually powerful medicines, such as morphia, strychnia, belladonna, corrosive sublimate, etc. ; but this plan of treatment is rarely or never employed except in the cases of emergency already referred to.

Hypodermic Medication or Injection.—This term denotes, as does its Latin synonym, *subcutaneous injection*, the introduction of medicinal articles in perfect solution into the areolar tissue beneath the skin. This is effected by means of a fine, lancet-pointed

syringe of minute calibre, capable of holding a drachm or less of the fluid, and made of glass, hard rubber, silver, or gold. Owing to the care required in the use of this method, it ought not to be resorted to without the instruction and advice of a physician. The parts selected for the injection are usually the outer surfaces of the thighs, arms, and legs, or the abdomen, and the back—regions

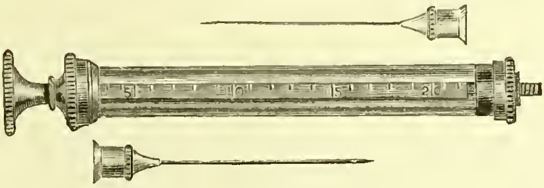


FIGURE 186.—Hypodermic syringe, with hollow needles.

which one would naturally suppose would be particularly adapted for this method of medication. The articles introduced in this way are some of the most powerful of the materia medica, being arsenic, morphia, prussic acid, strychnia, atropia, and a few other agents, which need not here be enumerated. Hypodermic injection of medicines is resorted to by physicians for cases in which, as in severe suffering, immediate relief is demanded, the action of the medicine—which, by the way, is given in smaller doses than by the mouth—being exerted speedily.

Through the Mucous Membrane.—Medicines are sometimes applied to the mucous membranes covering the eye, to that lining the alimentary canal from the mouth to the lower bowel, to that of the various parts of the respiratory organs, and of the genito-urinary apparatus. Those applied to the eye, as eye-washes, are usually for a local effect, and this is also true of applications to the interior of the nose, the mouth, and throat. The inhalation of vapors of medicines has been recently practised with excellent effect in affections of the air-passages, and the spray of medicated solutions has been employed with similar effects in the upper part of the respiratory canal.

The usual method of administering medicine, with the view of affecting the general system or to produce the characteristic effects of drugs, is by the mouth, through the absorbent power and sympathetic action of the stomach. Some medicines, such as diffusible stimulants,—brandy, alcoholic liquors, etc.,—are absorbed directly into the veins of the stomach, while others of a different texture and consistence are sometimes digested.

When circumstances render it desirable to administer medicines by the bowel, as sometimes happens when we wish to make an

impression on neighboring organs, as the bladder, etc., or the stomach is too irritable for their introduction by that channel, or the want of consciousness prevents their being readily swallowed, we should administer, as a rule, injections —or *enemata*, as they are technically called —or *suppositories*, which are medicinal substances incorporated with some material—usually cocoa butter or gelatine —capable of gradual or ready solution. The latter are introduced into the bowel, or, if necessary, into the vagina, to produce some local or possibly a general therapeutic effect. As a rule, the amount of fluid to be introduced into the bowel for purposes of absorption must be small and unirritating, so that no purgative action will result. Beef-tea and cream, cod-liver oil, blood, and other nutritious articles, may thus be prescribed in cases in which it is impossible to receive nourishment in other ways.

Infusion is the operation of injecting a remedy directly into a vein. It is attended with considerable risk, and is rarely employed in other cases than those of emergency, such as hydrophobia, snake-bite, and poisoning of certain kinds, when other means have failed or are not available. The well-known but curious fact is exhibited in the process of infusion that medicines exert a special preference for certain parts of the body; an emetic, for example, producing vomiting even when introduced in this way. Saline solutions, made by dissolving salts of sodium in water at a temperature of 100° to a specific gravity of 1,020, have been used in the collapse stage of cholera, in the course of diabetes, etc.

Transfusion is a term usually employed for a mode of supplying healthy blood to the system in diseases in which the blood already circulating has become so thoroughly vitiated as to render any other treatment hopeless. Human blood is not absolutely necessary, lamb's blood being found by experience to effect the object sufficiently well. About four to six ounces may be transfused, and the operation is especially applicable in cases of severe and alarming hemorrhage, no matter what may be its cause. Injection into the arteries has also been practised with success, and transfusion of milk has recently been employed.

[General Systems of Treatment.

It is a natural tendency of thoughtful persons to reason upon the causes of physical phenomena, and it is, therefore, by no means strange that, at different times, theories regarding the modes by which medicines produce their effects should have been almost as numerous as the observers. Occasionally there have arisen men gifted with a marked tendency to generalize upon the basis of

such facts as were then known to them, and they have attempted to arrange remedies in classes according to laws of action which they have themselves evolved. The attacks upon, and support of these theories, have filled myriads of volumes which have now little scientific value. In the meantime the progress which has been made in the discovery of new aids to observation has enlarged the range and variety of facts which may be appreciated, and it has now become yet more difficult to establish, from an almost chaotic mass of accumulated information, a law governing the therapeutic action of remedies which does not utterly fail to answer the requirements of science. Even the most familiar remedies vary in their effects, according to the circumstances which may attend their administration; and although there may be an apparent tendency to conform with some common principle of action, the exceptions are so numerous and important that little good has been derived, as yet, from pursuing the study to any extent. Indeed, one who devotes himself to the establishing of a therapeutic law is quite apt to become biased in his judgment, and to overlook facts and conditions which would be apparent to a less prejudiced observer. For this reason it has generally been considered a matter of duty to adopt no exclusive theory or dogma regarding the action of medicines, but to remain at liberty to accept the labor of any observer on the basis of its merit. Any physician, therefore, who claims to practise according to a "pathy," "ism," or theory, by whatever name it may be called, and who confines himself to an honest and conscientious conformity therewith, deprives his patient of a multitude of resources which have been accumulated during centuries of experience. If, on the other hand, he makes use of such resources, while claiming adherence to an exclusive dogma, he professes to be that which he is not.

Homœopathy.—The theory which physicians of this school adopt regarding the action of drugs in disease is that certain substances, when given in proper doses, have a specific action in curing diseases, the symptoms of which are similar to those produced by these drugs when they are given to a healthy person in doses sufficiently large to disturb the functions of the body. From this has been formulated what they consider to be a law, viz.: that "similars are cured by similars." Among homœopathic physicians there has been a wide difference of opinion as regards the proper size of a dose—some using exceedingly minute or infinitesimal quantities, while others make use of doses which are quite appreciable. Hahnemann, the founder of Homœopathy, himself belonged to the first-named class, and those few who, at the pres-

ent day, adhere strictly to his theories and practise accordingly, are known as "Hahnemannians."

In this system of practice comparatively little importance is usually placed upon the essential nature of diseases and the pathological or morbid changes (as distinguished from healthy conditions) which occur in the various portions of the body, and which, to a greater or less extent, are characteristic of the diseases in which they are found. On the other hand, attention is mainly devoted to symptoms, many of which are more or less common to various diseases, and numerous observers, presumed to be in health, have made an enormous collection of similar symptoms, resulting from so-called "provings" upon themselves and others, of a great variety of substances. These symptoms embrace every conceivable vagary of mind and body, and have been published as guides for the use of these substances in cases of sickness, in the course of which similar symptoms may be manifested. It would be almost beyond possibility for the memory to retain all these symptoms, or to distinguish those which are important from others which are trivial.

Since the various symptoms presented by an invalid and capable of being distinguished by careful observation and inquiry (provided the patient be conscious of sensations) must be very numerous and changeable, even in a single case, it is considered by homœopathic physicians to be essential that the remedies to be employed should be similarly varied and given in the purest and most active form obtainable, and that their effects should not be counteracted by other influences, whether in form of medicine, food, odors, etc. This must necessarily lead to frequent changes in treatment, and, as a matter of expediency, homœopathic physicians are themselves obliged to supply most, if not all, of the remedies required.

While it is not to be denied that many substances, even if taken in very small doses, are yet capable of producing effects upon the living body, this does not appear to be universally the case.

The fact must also be considered that in all diseases there are many symptoms which are liable to change from day to day—even from hour to hour—without, so far as we are aware, having any connection which we can consider important with the *natural* progress of these affections toward death or recovery; so that excessive attention to symptoms which may be trivial in importance, is liable to obscure an appreciation of the inherent tendencies of the disease and of the natural effort in nearly all cases toward recovery, and may cause us to attribute to inert substances a curative value to which they are not entitled.—Ed.]

Thomsonianism.—This system, named after Samuel Thomson, of New Hampshire, who flourished at the end of the last and the beginning of the present century, is based on the belief entertained by him that all diseases are the effect of one proximate cause, and should be treated on the same general principles. His theory was that heat is life, and cold is death, or, in other words, that heat is the cause of life in motion, and the absence of heat is death ; that cold or loss of heat is a universal cause of disease, and that in all cases of disease, however produced, there is a lessening of the power of internal heat. He believed that the means employed for curing disease should be such as will increase the heat, and that thus obstructions would be removed from the system, the digestive powers of the stomach restored, the natural perspiration encouraged, etc. With the view of establishing internal heat, and fulfilling other indications, he employed various articles and preparations, which he numbered, No. 1 being lobelia, No. 2, capsicum, and so on ; and externally he had great faith in the steam-bath. For his remedies he depended entirely on the vegetable kingdom, and the followers of his school at the present day, adopting his views and principles, are practitioners in a botanical course of treatment. It is not necessary to discuss the fallacies of the theory on which such a mode of treatment is based.

Eclecticism or Eclectic Medicine.—Judging merely from the non-medical definition of the word "eclectic," every member of the medical profession should belong to this class, for they are defined as those who do not follow any one model or leader, but choose at will from the tenets, works, etc., of others. The medical Eclectics, so-called, of the present day have assumed this name to distinguish them from other schools of medical belief. The exclusive Eclectic system of to-day, founded about the year 1840, is the practical successor to the Thomsonian School, which it resembles in its claims to the employment of vegetable remedies, to the exclusion of mineral agents, and its professed opposition to heroic treatment by the allopathic system, a mode of administering large doses—which, by the way, has been obsolete for many years. In addition to this, the Eclectics profess to practise according to any principles—allopathic or homœopathic—they may choose, indicating in this a lack of exact principles in their therapeutic system.

Special Modes of Treatment.

Under this head may be considered such systems of medication, based on rational views of therapeutics, as are applicable to the treatment and cure of disease, and are practised at the present day

in different parts of the world. Some of these are not susceptible of universal application, but are restricted in their use to the direct management of particular diseases. As will be presently seen, they do not always involve the employment of drugs, which are at times supplemented, or rather replaced, by dietetic and other treatment with equally good results.

Expectant Treatment.— The recognition of the instinctive power of nature in the restoration of diseased parts to health has led to the adoption of a plan of treatment based entirely on this fact, to the exclusion of drugs. In other words, the followers of this method wait until they discover whether nature is going to effect a cure unassisted, before they have recourse to any remedial agents. In doing so they delay frequently until the time has gone by for the successful administration of remedies. The danger under the expectant plan is, that the part involved may not only continue in its diseased action, but that other parts may also suffer by sympathy.

Specifics.—These are medicines which are supposed to possess a power to arrest special diseases under all circumstances. Certainty of action of this kind must be limited to a very few of the articles employed by the physician. Quinia is as nearly an illustration of this power of specificity as possible ; but it is not an absolutely infallible remedial agent in the disease—intermittent fever—for which its specific power is claimed.

Dietetic Treatment.—Valuable therapeutic effects may be expected from modification of diet, and its judicious increase or diminution in quantity, even without the administration of any medical treatment. Restriction to special forms of diet will sometimes be all that will be required. It is not our province in this place to discuss the general consideration of the theories of dietetics, the food and regimen best adapted to infancy, childhood, or the maternal condition, the various circumstances and influences of trades and occupations, climate, etc., as affecting the quality and quantity of food to be taken in health. These belong to another chapter of this work. The dietetics of sickness is but little understood, being confined to a few articles, in the popular estimation, beyond which it is not safe to venture without risk to the patient, who must either be restricted to the use of "slops," as they are pleased to call them, or have full license to indulge in a very incongruous diet-table.

In *inflammatory conditions* of all kinds, wherever seated, arising from local congestions, accident, or as a result of antecedent disease, the general principle is recognized that nourishment, given to maintain and encourage a healthy condition of the blood,

is much more desirable and beneficial than starvation, which clogs the circulation with effete materials, and renders it unfit in its vital and physical properties for the healing processes of nature. Unless there is loss of appetite, rendering small and often-repeated doses of liquids necessary, the stomach is likely to digest articles of firmer consistence, for it is not usually sympathetically affected, as in acute fevers. Stimulants should only be allowed in small quantities, or entirely prohibited.

Special Dietetic "Cures."

As a general rule, these plans of treatment are independent of any other medical administration than such as are associated with appropriate hygienic and other surroundings. The various "cures," as they are called, which are embraced under this head, are wholly based on the theory of the adaptedness of certain dietetic articles to special morbid conditions. They are not general systems of treatment applicable to diseases in general, but such as can be adopted by the believers or followers of any school of medical doctrine. Among these may be mentioned, for purposes of description, the grape-cure, the whey-cure, milk-cure, Bantingism, etc.

Milk-Cure.—Restriction to a diet composed wholly of milk is applicable to the treatment of a number of morbid conditions. The amount to be administered varies with the individual, some patients being able to take much larger quantities than others, as it frequently disagrees with the stomach, producing also constipation or diarrhœa. It is often digested with difficulty, and even when it agrees with the patient it occupies about three hours in its digestion. Under its constant employment the patient soon loses weight, sometimes becoming much debilitated, and the pulse accelerated ; but gradually the latter becomes more natural in its rapidity, and no further diminution of weight is perceptible.

When milk is thus administered, it should be given at first in doses of three or four ounces every three hours, until the system is accustomed to its use, when the quantity may be increased to a half pint, or a pint, slightly warmed, several times a day. In very sensitive stomachs the milk may be given at first with small quantities of lime-water, or some other mild alkali, or boiled or skimmed, especially in affections of the bowels. After the skimmed milk has been employed for a few weeks, the diet should be gradually varied by a combination of other nutritious articles with the milk, until the period would seem to have arrived at which the milk-diet is no longer necessary.

The diseases in which the milk-cure has been resorted to have naturally been those associated with disorder of the organs of digestion, such as dyspepsia, ulcer of the stomach, dysentery, diarrhœa, and the treatment has also been applied to dropsical conditions, and to diseases attended secondarily with dropsy, on the ground that benefit accrued from the copious discharges often produced by it from the bowels and urinary organs. It may be readily seen that the whole system of nutrition may be modified by such a dietetic treatment, and that gouty affections and certain forms of skin disease attended with acidity might be benefited by a course of this kind.

Buttermilk-Cure.—Buttermilk has been employed for infants and adults, but especially for the former, under the view that the lactic acid which it contains renders it more readily digestible. As it is not as sweet as the milk of the mother, it requires the addition of a small amount of sugar. It has been suggested that in giving it to the young child, a spoonful of wheat-flour should be added to a pint of buttermilk and boiled, the mixture to be given at a temperature of 95° or 96° Fahr. twice a day. In the adult it is given in some of the same conditions as have already been mentioned for the employment of the milk-cure, as diabetes, albuminuria, affections of the stomach, etc.

This mode of treatment was first resorted to in Holland. Should constipation, instead of diarrhœa, attend either of these forms of dietetic treatment, gentle, not violent, aperients should be employed to counteract it.

Koumiss or **Kumyss.**—This is a beverage originally used by the people of Tartary, resembling sour buttermilk, but being less greasy. It is usually prepared from mare's milk, which is placed in a leathern churn for several days until it becomes sour, and is afterwards bottled. The true Koumiss is sometimes imitated by adding sugar of milk to cow's milk, and fermenting with brewer's yeast in open tanks, frequently stirring, skimming off the cheese and butter from the surface, and transferring to bottles while active fermentation is still going on. The genuine Koumiss does not usually keep well, and should therefore be drunk at the locality in which it is produced. It is of an acidulous sweetness, and in small quantities increases the appetite ; in large doses, replaces solid food as an article of diet, a pint of it being equivalent to two ounces.

The Koumiss-cure is prescribed in a variety of constitutional diseases attended with emaciation, as consumption, chronic bronchial disease, convalescence from debilitating diseases, etc. It is said that in Russia, where the cure is rigidly followed, it is

taken almost continuously, at brief intervals during the day, until twelve or fifteen pounds are consumed, two mares being required to supply this amount.

Whey-Cure.—Whey, which results from the coagulation of milk, the butter and caseous matter becoming separated, is employed in Switzerland and the Alpine regions of Germany, for medicinal purposes ; but judging by its composition, its remedial properties must be very limited. In some of the German watering-places a space is set apart for the followers of this system ; but the whey is scarcely anything more than an agreeable diluent, the sugar possessing slightly nutritive and alterative effects ; but the chief good resulting from its use undoubtedly depends, as in some other modes of cure, on the new impressions created by change of air and scene.

Hunger-Cure.—From the name appropriated to this form of treatment, it might seem a misnomer to call an effort at exclusion of articles of diet a variety of diet-cure. It will be readily seen that conditions of the system might arise in which restriction to a greatly diminished scale of dietetic articles might be attended with beneficial results. The effects of a want of proper quantity and quality of food are often seen in the production of scurvy, intestinal disorders, gangrene, etc. All the secretions of the body become affected ; the lungs give off a diminished amount of carbonic acid, the bowels become constipated, the nervous system becomes impaired, the urinary secretion diminished, etc. If such be the results procurable by an excessive degree of abstinence from food, why may not the whole system of nutrition be influenced by a judicious restriction and qualification of the diet, and satisfactory therapeutic results be attainable by such dietetic regulation?

Such good effects have been found to follow in the treatment by low diet and perfect rest, of aneurism, as is elsewhere stated.

In obesity this mode of treatment, based on the principle of utter self-denial, has been especially recommended of late years. The general principles of the treatment are not new, but have been of late years popularized by the publication of a letter by a Mr. Banting, of London, giving the results of the hunger-cure in his case. The treatment has therefore received the name of *Bantingism.* Under its employment his weight was reduced nearly fifty pounds in less than a year. It will be seen, from the following table, that all starchy, saccharine, and oily matters, which, from their chemical composition, are likely to create fat, are rigorously excluded, although it must be confessed that such exclusion will in many cases exert an injurious effect on the system by withhold-

ing from it elements that may be absolutely essential to a healthy vitality. His bill of fare was as follows :

For Breakfast.—Four of five ounces of beef, mutton, kidneys, broiled fish, bacon, or cold meat of any kind except pork and veal, which are decidedly indigestible ; a large cup of tea, without milk or sugar; a little biscuit, or an ounce of dry toast, brown bread, or ordinary bread crust; an egg, if not hard boiled.

For Dinner.—Five or six ounces of any fish except salmon, herring, and eels (which are of an oily nature) ; any meat except pork and veal; green vegetables, and any vegetables except potatoes, parsnips, turnips, beets, and carrots ; an ounce of dry toast ; fruit out of a pudding; any kind of poultry or game, and two or three glasses of good claret, sherry, or madeira ; champagne, port, and beer being forbidden.

For Tea.—Two or three ounces of fruit, a rusk or two, and a cup of tea without milk or sugar. A little coffee may be permitted.

For Supper.—Three or four ounces of meat or fish, similar to dinner, with a glass or two of claret.

He also took, once or twice daily, a teaspoonful of aromatic spirits of ammonia with ten grains of carbonate of magnesia, lest by restriction to such an exclusive diet an acid condition of the system should result, which might be attended with the development of gouty or allied affections.

Grape-Cure.—This is another form of exclusive diet, grapes being the sole article used. It has been but little employed in this country, but is well known in France and Germany. No exact limit is prescribed in amount, as many pounds of ripe grapes being eaten in the day as the capacity of the patient will admit. Where this special treatment is systematically followed in the grape season, rules are laid down for the times during the day at which the fruit shall be eaten. This regularity of the meals, if we may so call them, co-operates with the salutary effects of change of scene, etc., to benefit the condition of the patient. Deducting from consideration the water and insoluble ingredients of the grape, there is but little left except grape-sugar, tartaric acid, gum, and a fractional amount of nitrogenous matter, wholly incapable of supplying sufficient nourishment.

It has been resorted to in a variety of diseases, those of the stomach and bowels especially, and even in consumption, scrofula, and kindred constitutional affections.

Water-Cure.—The treatment of disease by the use of water, externally applied, is included under the term "water-cure." It has been recommended by its enthusiastic devotees as an exclusive mode of combating almost the whole catalogue of diseases without any additional medication being demanded. When judiciously resorted to, it is rather an auxiliary to other treatment than an absolutely reliable, independent, therapeutic agent. The reputed

cures which were reported when it first came into vogue, a number of years ago in Europe, were probably much exaggerated.

The various stages of the water-cure, *hydropathy* or *hydropathic treatment*, as it is variously styled, are the following: Sweating; the use of the cold bath ; the drinking of cold water ; and the douche.

Sweating.—This stage of treatment is practised as follows:—Very early in the morning the patient is taken from his bed, without his night-clothes, and wrapped carefully in a blanket. He is then placed on a properly arranged bedstead, with additional bedclothes put over him, the atmosphere being at a moderate temperature. In a few moments he feels warm, and begins to sweat. The windows of the apartment are then opened, and cold water is handed him to drink—a small quantity at first, increased at intervals of every fifteen minutes. This produces a copious discharge of perspiration, which continues to flow for several hours, or as long as may be thought desirable for the case under treatment or from the endurance of the patient. Sometimes the direct application of moisture is necessary to produce sweating, when the previous treatment fails to effect this object. In such an event the

Wet sheet or *wet pack* or *packing* is applied. It consists of wrapping him at once in a sheet thoroughly soaked in cold water, and then wrung out, and then applying over this the blanket or other woollen covering, and the wrapping above referred to, with friction, etc. It may be applied generally or merely over the organs affected, etc. The immediate effects of the wet sheet packing may be obtained in another way: the body being wrapped in the sheet, dipped in cold water, and then rubbed actively with the sheet, the patient standing during the operation, and friction being continued afterwards with dry, coarse towels.

Cold Bath.—This stage follows that just described. The coverings being loosened, and the patient's feet being covered with stockings and shoes, he proceeds to the cold bath, into which he enters, the temperature of the water being about 50° to 55° Fahr. He first wets his head and breast with cold water before entering the tub, and during the bath exercises himself as much as possible by movements, washing, and friction of the surface. He remains here ten or fifteen minutes, and, covered with light but warm wrappings, returns to his room, dresses, drinks cool water, and takes exercise out of doors for about an hour, after which he breakfasts.

This mode of treatment is too violent for weak and delicate subjects, who are allowed to bathe in a shallow tub, the water being only a few inches deep, and at a temperature of from 55° to

60° Fahr. The same exercise is gone through in the water, but not continued for the same length of time. Sometimes a more temperate bath is resorted to before the patient is subjected to the full cold bath treatment, or both may be used, in some cases the patient passing successively from one to the other; or the temperate bath may be employed alone, when it is not desirable to produce sweating. In the latter case the patient can sit for an hour or more in the bath. Sometimes the bath is replaced by washing with cold water, assisted by friction, or cold sponging, and this treatment will often be sufficient, especially in the very young, or as a preliminary step to the employment of the cold bath.

Cold Water Drinking.—It is astonishing how much water is sometimes imbibed by the subjects of water-cure treatment. The amount is of course regulated by the medical attendant according to his own fancy, but it is no uncommon thing for the patient to take a dozen or two glasses of cold water (45° to 55° Fahr.) in the course of the day. Regular times are prescribed for this part of the cure, especially during exercise and early in the morning. With many persons this copious drinking of cold water will produce symptoms of indigestion, known as *aqueous* or *water-dyspepsia.*

The Douche.—This stage of the treatment consists of the direct application of water falling from a height upon the body of the patient, or striking on such a part as may need a special application of this kind. Of course this is contra-indicated when there is an irritable condition of any special organ or region; and certain parts of the body, as the pit of the stomach and the chest, should not, in delicate persons, be attacked in this way. The judicious application of the douche in some affections of the head is often of great service, as has been found to be the case in institutions devoted to the care of the insane, although the experience of all superintendents of such institutions has not been equally favorable to its employment.

The douche, in the continuation of the water-cure treatment, is applied as follows: The patient, being stripped of his clothing and wrapped in a sheet, enters the space allotted to the operation, and, after wetting his head and body with water in his hands, allows the douche at first to fall for a moment or two on the back of his neck, and, while rubbing himself everywhere, gradually receives the douche over his entire body, receiving it at last directly on such parts as demand this special attention. The operation should never last longer than ten or fifteen minutes, after which the patient is thoroughly rubbed and re-dressed. As a rule, it should not be resorted to in cases of great debility or highly nervous or

febrile conditions. The tube for applying the douche may be arranged to be vertical, oblique, etc.

This constitutes the continuous general treatment adopted by the advocates of the water-cure system. It is followed day after day, combined with regular diet and careful attention to all the hygienic surroundings, to which last some credit must surely be given. Auxiliary modes of special treatment also form a part of the plan of treatment by this system. Certain local applications of water are recommended in conjunction with the measures we have enumerated, such as the foot bath, head bath, sitz bath, etc.

The *Sitz Bath.*—This is what is generally known as the *hip bath*, in which the patient sits, the exposed parts of the body being protected by wrappings, and the central portions immersed in the water as far as the navel. This bath is used, either for the direct local effect it may have in giving tone to the urino-genital and other organs, or for its indirect action in impressing parts at a distance, as in inflammatory affections of the head, chest, etc. It may also be resorted to in chronic affections of the organs connected with digestion, as of the liver, bowels, etc. Here the patient should resort to the sitz bath for an hour or more, while in the former case he should not remain for a longer period than ten or fifteen minutes. This bath is used alone or is associated with the douche, the packing, etc. Friction of the parts immersed is to be employed during the process of bathing, and subsequently of the whole body.

Included in the water-cure treatment are local applications of cold water to the feet and to the head, fomentations of various kinds, injections, washing the mouth with cold water, etc. Whatever the form of treatment adopted, the patient is placed under a plain but plentiful diet, under which the appetite grows more active, while stimulants of all kinds are strictly prohibited. Without entering into any discussion of the merits of the system or its defects, or its inapplicability to the universal treatment of disease, it may well be questioned whether the good effects sometimes observed may not be due largely to regularity of living, salubrity of atmosphere, attention to hygienic details, and confidence of the patient in the pursuit of health according to definite rules.

The various therapeutic actions of water will be more appropriately inquired into, after considering more fully the subject of baths and bathing.

Baths.

Water, for purposes of bathing, may be employed *cold, warm*, and *hot*, or in the form of *vapor*, either simple or medicated. The water may be applied by direct immersion of the body, by affusion, either by dashing over the surface, by sprinkling, or by the douche, or shower bath, or by fomentation with simple or medicated solutions. The temperatures which distinguish the simple baths may be briefly stated, approximately, as follows :

BATH.	WATER.	VAPOR.	AIR.
Cold	33° to 65° Fahr.		
Cool	65° to 75° "		
Temperate	75° to 85° "		
Tepid	85° to 92° "	90° to 100° Fahr.	96° to 106° Fahr.
Warm	92° to 98° "	100° to 115° "	106° to 120° "
Hot	98° to 112° "	115° to 140° "	120° to 180° "

The diverse effects of cold, warm, and hot bathing may be stated to be the following : Immediately upon entrance into the *cold bath*, the temperature of the surface is reduced, a sensation of chilliness is experienced, the skin loses its color, and a generally depressed feeling ensues. Undoubtedly the nervous influence is transmitted to the internal organs, and the blood is driven from the surface. Soon reaction takes place, and a general glow occurs over the surface, while there is an evident feeling of exhilaration and increased muscular power, followed by augmented appetite. Too long-continued exposure to the cold, especially by the debilitated and nervous, is apt to be followed by a depressed condition of the general system, enfeebled pulse, etc., the anticipated reaction being delayed or wholly absent.

Bathing in *warm water* produces an entirely opposite effect, the surface becoming reddened, the pulse quickened, but with less force, and sensations of oppression, giddiness, languor, etc., experienced, depending in amount and degree on the length of time the patient remains in the bath, or the elevation of the temperature. Sweating rapidly occurs under the influence of the warm bath, which is greatly increased in quantity by increase of temperature of the bath. The amount of excitement or relaxation which may be considered desirable in each case must govern the prescriber or the patient as to the length of time requisite for the bath.

The *hot* and *vapor baths* should be regarded mainly as therapeutic agents, not to be resorted to, except for the treatment of

morbid conditions, and with a full appreciation of their exciting and deleterious effects. The patient should, as a general rule, remain but a few moments in the cold bath, while he may remain ten or fifteen minutes in the tepid bath, and from half an hour to an hour in the warm bath. In some of the European warm springs, frequented by invalids, hours at a time are spent in the water, in conversation, reading, and other rational amusements.

Vapor baths are either simple or medicated, being derived from hot dry air, or aqueous vapor, or having suspended in them various medicinal substances. In some parts of the world, as in Carlsbad, Pfeffers, and other European localities, these exist naturally, being the vapors derived from hot mineral springs. The effect of immersion in a dry and a moist vapor bath is similar, so far as increase of the heat of the body and of the blood is concerned, but evaporation occurs more rapidly in the dry vapor leading to the excitement and irritation of the surface, the moist vapor being condensed, but evaporation being retarded by the saturation of the air with moisture. Dry heat is much more readily tolerated. The vapor is not as powerful a conductor of heat as water, and therefore a temperature of 100° Fahr., of a moist vapor bath, will not have any greater effect on the circulation than a warm, or rather a tepid water bath of 90° Fahr.

The *Russian bath* is a vapor bath, usually of the temperature of 122° to 133° Fahr. In a large hall, arranged with rows of seats for sitting and reclining bathers, a stove is placed containing stones which are heated to a very high temperature, vapor being produced by water poured upon them. The bather is exposed to this vapor for fifteen or twenty minutes, until profuse sweating occurs, when the body is washed with soap and water, gently switched with twigs, and tepid or cold water afterwards poured over his head by the bucketful. At first the patient on entrance into the vapor bath experiences a sense of fulness of the head, heat of skin, and difficulty of breathing, all of which are relieved by the production and evolution of a large additional supply of vapor produced by the attendant in the manner above described.

The action of the Russian vapor bath is analogous to that of the extemporaneous form of vapor bath developed by the action of vinegar poured over hot bricks under the bedclothes, in cases of rheumatism.

The *Turkish bath* consists of several consecutive processes. The bather undresses in one apartment, and, dressed in a loose wrapper and sandals, passes into a second apartment, moderately heated, and then into the bathing-room proper, whose temperature is 100° Fahr. Here reclining he is thrown into a profuse sweating, dur-

ing which he is rubbed and washed thoroughly clean by an attendant with a horse-hair brush, and afterwards subjected to a process of kneading at the hands of the attendant, his joints being manipulated at the same time. The bather is then well washed with soap and hot or cold water, as he prefers, after which he repairs to the second room again, whence, attired in a loose wrapper, he passes after a few minutes to the first room, where he dresses and reclines for half an hour or longer, resting himself, smoking, or taking coffee. The bath must always be taken before a meal, when the stomach is empty. Local congestions of various kinds are removed under the influence of the Turkish bath, noxious matters eliminated from the blood, and a healthy condition imparted to the skin and mucous membranes. Rheumatism, gout, skin diseases, fatness, dropsy, etc., have all been benefited by its employment. It should never be resorted to in cases of disease of the nervous centres, impediment to the circulation, vertigo, etc., or by those advanced in life.

A *mud bath*, or *earth bath*, as it is indiscriminately called, consists of immersion of a portion or the whole of the body, except the head, in mud or earth. This style of bath is resorted to in Germany and France, especially by invalids and others visiting the warm mineral springs, the mud bath being nothing more than the warm water mixed with the earthy deposit in the immediate vicinity, or with earth brought there for this purpose [a sort of peat being the kind of earth used in some of the German resorts]. It is therefore a thermo-mineral bath. At times it has the consistence of a very soft poultice, and is sometimes heated by steam to a temperature of 85° to 100° Fahr. Mud baths may be carbonated, chalybeate, saline, or sulphurous, according to the locality in which they are found. They are said to excite the skin more than ordinary baths, with increased rubefaction. The earth bath is used for three-quarters of an hour to an hour, as a rule, but this is regulated by the toleration of the patient. The same mud is not twice used. It is washed off with ordinary spring-water, the skin being rubbed, and gradually cooled, the bath having put the patient into a perspiration. This form of bath is used in chronic skin diseases, in some forms of nervous affections, as hysteria, in neuralgia, and gouty and rheumatic paralysis or stiffness of the joints.

The *sand bath* acts on similar principles, but the material is different, being the sand and exuvial matter thrown up on the sea-shore, and exposed to the heat of the sun. Near certain hot sulphur springs, the addition of that ingredient imparts a new element. This form of bath is now but little used, although in old times resorted to for the treatment of scrofula, scurvy, gout,

rheumatism, and many other ailments. Sweating and eruption follow its use, as in the mud bath.

A form of medicated vapor-bath is that known as the *mercurial vapor bath*, recommended in the treatment of syphilis. It may be made in various ways, but the most simple arrangement is the following:—A tin case, made by an instrument-maker, is employed, containing a spirit-lamp, and having in the centre, over the flame, a small tin plate, containing fifteen or thirty grains of calomel, and around this a kind of saucer filled with boiling water. The lamp being lighted, the apparatus is placed under a common cane-bottom chair, on which the patient sits, enveloped, chair and all, in blankets for twenty minutes. The water and mercury will then be found to have disappeared. No towel should be used, as the calomel would be wiped off by it.

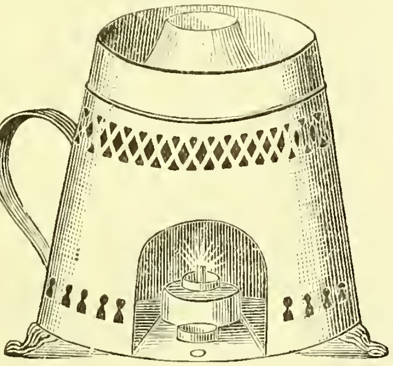


FIGURE 187.—Apparatus used for giving a mercurial vapor bath.

Compressed or *Condensed Air Baths.*—The rational use of compressed air as a therapeutic agent dates back about forty years. Introduced in France, the system of treatment has been employed in many other European countries in which medico-pneumatic institutions have been founded. The arrangement adopted in the best of these baths is to have a large hall for the receivers, and a number of chambers for the inhalation of pulverized medical agents, waiting-rooms, etc. The patient usually remains for an hour or two, and the increase of pressure is generally from a quarter to half an atmosphere.

The physiological effects of compressed air have been ascertained to be the diminution of the quantity of blood in the veins and auricles of the heart, and increase in that in the ventricles and arteries. The treatment seems, therefore, to be adapted to cases in which the venous system is mechanically congested or overfilled, as in chronic bronchitis, where the left ventricle of the heart is imperfectly filled and the tension of the arteries consequently diminished. Other effects have also been noted, such as an increase in the muscular energy of the body generally, an increase in the volume of the inspired air, augmentation in the force of the respiratory movements, increase of carbonic acid in the expired air, not wholly dependent on the increase of volume of air just alluded

to, increased activity of the digestive functions, and augmented amount of urinary excretion. The effects seem to be referable mainly to increased absorption of oxygen, and to the changes to which this gives rise. The tonic effect exerted by physical pressure on the relaxed and congested capillary vessels of the surface of the body and the mucous membranes of the air-passages, has been found beneficial, in chronic laryngitis, acute and chronic bronchitis, affections of the uterus, accompanied by arrest of the menstrual discharge, whooping-cough, acute catarrhs of the mucous membrane of the nose, pharynx, etc.

Medical Gymnastics.

Movement Cure.—These are regularly systematized hygienic exercises, performed with or without mechanical or other aid, by either sex, with the view of developing muscular power, and preventing and curing disease, under the influence of properly regulated gymnastics; the chest, for example, may be so developed as to give increased capacity to the important organs contained within it. There is no doubt that in a very large number of persons proper play is not given to the exercise of the muscles of the shoulders and chest, on account of inactivity of the arms; or of the abdominal muscles, or of the muscles of the back, from insufficient motion of the trunk. Under the guidance of a physician as to the choice of gymnastic exercises to be practised, suited to the especial case, medical gymnastics may become an important curative agent. The general principles of their employment are practicable, except under febrile conditions, acute inflammation, pregnancy, etc. Medical gymnastics should be performed immediately before meals, the clothing to be worn such as will not restrain the free movements of the body, and the exercise must not be persisted in should the respiration and circulation become sensibly accelerated. The gymnastics must be performed regularly and quietly, without jerking and without muscular pain.

The movements to be practised are numerous, and cannot therefore be fully described. Each movement must be executed from ten to twenty times. They include a rotatory movement of the head and a turning of the head, in cases of stiffness of the neck; raising the shoulders together, to enlarge the cavity of the chest upward; circular arm-movements, in case of defective action of the shoulder and narrowness of the chest, and therefore employed in asthma, commencing phthisis, etc.; raising the arm sideward, without bending the elbows, for the promotion of healthy respiration; throwing back the elbows as far as possible; stretching the

arms downward behind; unequal breathing, by placing one arm pressed under the arm-pit against the ribs on the healthy side, while the other side is made more free by passing the arm above the head, etc., etc. Almost every movement of the body, of feet, hands, arms—indeed, of the whole external muscular apparatus—is brought into requisition, alone or in combination, to produce some useful remedial effect. Even the infirm and deformed can be brought under the influence of the system while in a sitting or reclining posture. In Sweden, Germany, Russia, and elsewhere, medico-gymnastic institutes have been established to carry out the principles of the system.

A modification of the movement-cure is the substitution of machinery worked by steam for the muscular power otherwise required. The advantage is the facility of execution, steady exercise, and a graduated increase of force. Machines are constructed arranged in such a way that they may be worked by the various sets of muscles. In one institution in Sweden there are about seventy forms of apparatus, producing about fifty different movements, many of these being active movements of the arms, legs, and trunk, others being passive. The patient is in a state of repose, but when the machines are connected with a steam-engine, involuntary movements of flexion, extension, abduction, adduction, etc., of the limbs occur; joints are made to respond, and all the practicable movements of shaking, hammering, tapping, kneading, rolling, rubbing, etc., are accomplished, through the agency of the machines, involuntarily by the patient. Under such treatment chronic affections, as of the heart, constipation, diseases of the joints, rheumatism, spinal curvature, etc., are often relieved, and expectoration is said to be facilitated in cases of catarrh.

The movement-cure was known and practised in ancient times. The system scientifically performed at the present day is generally known as the Swedish movement-cure, because it was first fully developed by Peter Henry Ling, a citizen of Sweden, who made a special study of this as a powerful means of producing harmonious organic development of the body. He believed that the education of the people was incomplete without it, and studied carefully the effects of applied movements on the bodily and mental condition of mankind. Curative movements were first practised by him in 1813, and an institution for the purpose was founded which soon, under government patronage, became developed into a great centre of therapeutic good. [See, also, the chapter on Exercise.]

Counter-Irritation.

Counter-irritants.—These may be defined as substances which excite irritation in any part of the body, with the view of relieving one existing in another part, near or remote. This is called *counter-irritation,* and the class of remedies thus employed is a very valuable one to the practitioner. Strictly speaking, this division of therapeutics should include almost all the articles used in medicine; but the term is generally restricted, at the present day, to external agents which induce a new local action by their application. The principal counter-irritants are rubefacients, cupping, blistering, the seton, moxa, issue, acupuncture, etc.

Acupuncture (acus "a needle").—This is a form of counter-irritation practised by the surgeon especially. It consists of the insertion of delicate needles, with metallic or rubber heads, and from two to four inches long, by a rapid rotatory motion, aided by slight pressure. But little pain accompanies the operation, and the needles are allowed to remain for some time—for minutes or hours, as may be deemed necessary. This form of counter-irritation has been employed in neuralgia, gout, rheumatism, paralysis, aneurism, etc.

Electropuncture is a form of acupuncture, except that the needles are introduced as convenient channels for the transmission of the electric current; but this form of counter-irritation is only resorted to in chronic affections, as of a neuralgic or gouty character, attended by obstinate deep-seated pains. The galvanic current is sometimes introduced by means of a wire, as of platinum, held between the blades of a pair of forceps, the current heating the wire to a red heat or even a more elevated temperature.

Baunscheidtismus is a variety of acupuncturation, unscientifically named after its proposer, Baunscheid. It is effected by the use of a disk about half an inch in diameter, into which about two dozen sharp needles are inserted, each about half an inch in length. A strong, spiral wire spring, about five and a half inches long, is attached to the disk, the other end of the spring being inserted into an elongated handle. The open extremity of the cylinder being placed firmly against the skin, the spring is compressed by drawing up the handle, and being suddenly loosened, the needles are driven with some force into the skin. Irritating applications are then rubbed into the punctured surface.

The term *Aquapuncture* (aqua, "water") has been employed for the process of introducing water under the skin through needles specially prepared for the purpose, although the hypodermic syringe

would answer equally well. Superficial pain is sometimes relieved in this way, and its employment has been extended to the treatment of lumbago, irritable bladder, muscular paralysis, etc. The immediate effect on the part to which it is applied is the production of a wheel around the puncture, redness, and increased temperature. It is usually a harmless procedure, admitting of repetition.

Rubefacients are substances which redden the surface, and by exciting the capillary vessels give rise to a determination of blood and an increase of nervous sensibility to the part to which they are applied. The results of rubbing with the dry hand, or with stimulating liniments—as of turpentine, ammonia, etc.—and the use of the common mustard-plaster, are illustrations. If carried beyond rubefaction, a blister may result. *Blisters* may be produced, however, in other ways, as by the application of boiling water, or of a red-hot iron, and by the ordinary blistering plaster of cantharides or Spanish fly. Blistering is not always a safe procedure, as in very young children, and in debilitated conditions of older persons, it may induce gangrene, and in some cases be attended with fatal consequences. Remedies which by acting as irritants increase the formation and discharge of matter (*suppurants*), and others which destroy the parts to which they are applied (*escharotics*) are also occasionally employed, the latter by the surgeon especially, with the view of producing a deeper and more extensive inflammation; issues and setons (to be described elsewhere) being frequently used to produce continued suppuration. *Cauterization* is sometimes practised with the hot iron, or with chemical substances, with the view of producing useful therapeutic effects, on the principle of counter-irritation, or *revulsion*, as it is sometimes called.

A physician must decide in what morbid conditions the severer forms of this class of remedies can be of therapeutic value as a means of diverting the manifestations of disease from an affected part. The ordinary mild applications, as of the mustard-plasters, poultices, and other simple remedies, can seldom do harm in the hands of any one (excepting the use of the latter with young children), but the more violent agents require much care and caution.

Stimulants.

This name is applied to a class of remedies which increase vital action. Their effect is more transient than that of tonics, the latter producing a gradual but continuous and permanent influence on the system. Some articles are both tonic and stimulant, while in others the virtues depend on a volatile oil, and

are purely stimulant. Stimulation, as by brandy, may be carried so far as to produce an opposite effect, as of depression or exhaustion, or even of brain-poisoning. All stimulants affect primarily the organ of taste, and when swallowed produce a sensation of warmth, sometimes of pain in the stomach; but they often facilitate digestion by causing a contraction of the stomach and bowels; by expelling wind, etc. They frequently stimulate the mucous coat of these organs to increased secretion, and cause a greater flow of blood to these parts. Some remedies of this class are rapidly diffusible—*diffusible stimulants*—as ether, alcohol, and volatile oils, and quite a number of these may be detected in the blood and urine by their peculiar odors. Stimulants increase the action of the heart and vessels, and produce greater fulness and frequency of the pulse. This stimulant action upon the circulatory organs is communicated to those of respiration as well, and the temperature of the body is also raised. A larger supply of blood being conveyed to the nervous system, the functions of the brain and spinal cord are correspondingly animated, sometimes so much so as to produce temporary mischief by over-stimulation. It will thus be seen that stimulants may at times, especially if injudiciously administered, be the means of exciting a condition of feverishness. Stimulants are also called *excitants*. If used to relieve the pain of colic or of flatulence, they receive the name of *carminatives* (*carmen*, a charm); when addressed to the heart and blood-vessels, they are called *cardiac stimulants;* under the name of *nervines* they are used as excitants of the nervous system in certain disorders of that apparatus. As a rule, stimulants are employed in conditions of debility or exhaustion, in various forms of nervous irritability and debilitated states of the circulatory apparatus, and should never be employed in inflammation, fever, etc., except under professional advice.

Remedies which Modify Nutrition.

An important class of remedial agents is recognized, generally known as *alteratives* from the influence they exert upon the system of nutrition, by the new impression they make through the medium of the absorbent vessels. They differ from tonics, inasmuch as the beneficial effects of the latter are probably accomplished directly through the nervous system. The changes effected by alteratives, such as iodide of potassium, mercury, etc., take place gradually and imperceptibly through the blood, which, becoming altered in character—improved in its quality—excites a new action in the capillary vessels, where all nutritive changes

occur, and in the parts supplied from them. Unhealthy conditions are influenced by this healthy change, and return to their previous healthy regularity and integrity. Alteratives, which thus modify nutrition, are adapted chiefly to chronic diseases, as their impression is not made speedily, but gradually. Some alteratives promote absorption, and effect the taking up of fluid that has already been deposited in unnatural places or quantities; but this takes place only through their effect on the nutritive functions. The chief alteratives employed by physicians are the preparations of mercury, iodine and its compounds, iodide of potassium—especially arsenic, the bromides of potassium, of ammonium, etc., cod-liver oil, chlorate of potassium, etc.

Massage.—By this term, of French origin, is understood the systematic application of manipulation, in the form of friction, percussion, and motion of parts. It is indeed a series of manipulations, intended to stimulate the organs of the body, increasing the temperature of the parts, producing new impressions upon it, and causing beneficial changes in the blood and nerve supply. When judiciously administered, this agent may have important therapeutic effects in the cure of disease, the relief of pain, etc. Sometimes muscular pain may be obliterated by the steady employment of massage. The principal steps in the use of massage are stroking and surface friction, termed by the French *effleurage;* kneading or deeper rubbing, *pétrissage;* percussion or tapping, *tapotement;* and motion, both active and passive. The two processes first mentioned excite the nerves of the skin and give involuntary exercise to the muscles without fatigue to the patient. The nerves of the skin are temporarily stunned by the percussion, and local changes take place which lead to modifications in the temperature and in the exercise of the functions of organs in the vicinity, while the good effects are also distributed to the nervous system generally by the new impressions thus created, affecting also the secretions of various organs, increasing the action of the bowels, etc.

ANÆSTHETICS.

Anæsthetics (αν, privative, and αισθανομαι, "I feel") are such agents as produce insensibility and unconsciousness. The articles employed are usually taken into the system by inhalation, although other substances, such as chloral hydrate, taken by the stomach, may produce similar effects. Ether, chloroform, and nitrous oxide are the substances popularly recognized as anæsthetics. Under their use surgical operations may be performed

without pain to the patient, while he is in a condition of absolute unconsciousness. The action of the nervous system controlling voluntary movements is temporarily arrested under their use, but the circulation and respiration are not materially disturbed, unless they be too long continued. It seems to be the experience of medical men that the robust do not yield as readily or rapidly to the influence of anæsthetics as those of weaker physical organization. Inveterate drinkers are not usually good subjects. It is commonly considered unsafe to give an anæsthetic after a full meal, or during the weakness induced by continuous fasting, and the effect will be more rapid if a large dose of some stimulant, as brandy or whiskey, be first given the patient. It is not necessary, after the inhalation has once commenced with ether, to exclude the air. The case is different with chloroform, the vapor of which is several times heavier than the atmosphere. In using this anæsthetic a very large admixture of air is absolutely necessary ; the quantity administered is quite small, the chloroform being dropped slowly upon a handkerchief or piece of thin cloth, about a teaspoonful at a time. A mixture of the two articles is sometimes employed. The action of nitrous oxide is much more transient, and is therefore not adapted to the performance of important surgical operations.

When anæsthetics are taken by inhalation, the first effect may be to produce resistance, on account of the patient's struggles for more air, of coughing, etc. ; but this soon subsides, and the stage of excitement and exhilaration rapidly follows, lasting but a few moments, and being succeeded by the stage of insensibility and total muscular relaxation. Sensibility to pain is diminished first, and the special senses of taste and smell wholly obscured—those of vision and touch, though irregularly exercised, being the last to be abolished. The functions of the brain become suspended, but the circulation and respiration, go on uninterruptedly. Should the anæsthetic effects be carried too far, these may also be suspended, and life become extinct from total failure of the functions of the heart and lungs. Death may result suddenly from other causes, sometimes from apnœa or asphyxia soon after the first inhalations of chloroform, perhaps from paralysis of the heart ; from interference with the respiratory functions and the circulation of the blood in the lungs and heart, by spasmodic arrest of the action of the muscles of respiration, or even by paralysis of these muscles ; or from the intensely narcotic effects of the agent employed.

ANTIPHLOGISTICS.

Antiphlogistics (αντι, "against," and φλεγω, "I burn"). Under this name is included a variety of remedial agents, so called on account of their employment for the purpose of combating or entirely dissipating inflammation. *Diet* may also be classed under this head, if administered with this view. A heroic treatment by the abstraction of blood was at one time the almost universal antiphlogistic, but this practice has now become a fashion of the past. Physicians of the present day resort rather to local than to general bloodletting, to internal medication, and to local treatment, to be presently mentioned. Should the inflammation depend on a purely local cause, which can be removed, it will probably subside without need for constitutional treatment.

Bloodletting offers a means of speedily diminishing the fulness of the vessels and the force of the heart's action, while at the same time it changes the character of the blood itself. When necessary to practise this operation, it should be resorted to early. The age, habits, and constitutional peculiarities of the patient, the stage of the disease, structure of the organ inflamed, etc., must all be taken into consideration in arriving at a conclusion as to the necessity of the operation, and this, of course, can only be done by a physician.

The medical agents usually administered *internally*, with a view to their antiphlogistic effects, belong to the class of cathartics, emetics, sedatives, diaphoretics, diuretics, and anodynes, all of which are assisted in their action by due attention to rest, —mental and bodily,—diet, regimen, hygienic surroundings, etc. *Cathartics* are administered usually at an early stage of inflammation, with various objects, such as the simple evacuation of the bowels; depletion from the lining membrane of the alimentary canal by abstraction of the watery portions of the blood; excitation of the action of the liver and glandular apparatus of the intestines; stimulation of the absorbent vessels to remove the products of inflammation; and their counter-irritant influence in setting up a new action and producing a diversion from the diseased one originally existing. They may thus relieve inflammation in distant parts not directly acted upon by the article employed. When judiciously prescribed, purgatives give a better opportunity for the after-employment of other remedies, as anodynes, etc. They are not admissible in inflammatory conditions or wounds of the stomach and bowels, in abdominal rupture, etc., in which cases rest, rather than movement, is the treatment indicated. Injec-

tions are sometimes given by the bowel to fulfil the simple indication of producing an evacuation, but they cannot have the same general effect as purgatives acting through the medium of the whole intestinal tract.

Mercurials are employed at different stages of inflammation, on account of the valuable alterative action exerted by them on the secretions, to produce absorption and removal of the deposits, effusions, and morbid results of inflammation. They are administered especially in the inflammation of fibrous and fibro-serous structures, such as give rise to gout, rheumatism, inflammation of joints, of the heart, liver, lungs, larynx, etc. In the form of calomel, corrosive sublimate, blue mass, and mercury with chalk, mercury is given in gentle but persistent doses, even to the extent of slight salivation.

Emetics are scarcely ever employed to prevent inflammation, except in the earliest stages, where the trouble seems to be aggravated by an overloaded stomach, or undigested food producing distress. They are, of course, inadmissible in inflammatory conditions of the stomach, liver, bowels, or urinary apparatus, wounds of the abdomen or its contained organs, fractures, etc.

Anodynes—agents which relieve pain and induce sleep—are usually employed where a calming and sedative action is indicated, and are administered in full doses, in order to produce a very decided impression. Opium and morphia (which is obtained from it) are the main reliance of the practitioner, and, as a rule, are given at bed-time. In combating the depressing and exhausting effects of severe pain, and in the inflammations of internal organs, they are especially applicable. Chloral, hyoscyamus, Indian hemp, etc., also belong to this class, chloral being frequently prescribed in combination with morphia.

Sedatives and *Nauseants* diminish the action of the heart and the force of the circulation, as well as the flow of blood to the affected part, and are employed in inflammations of various organs, as of the eye, lungs, fibrous structures, etc. They are of such general applicability that they are frequently administered alone, especially to the robust, without recourse to depletion by blood-letting, cathartics, or other agents; but they do not always produce a good effect when given to infants and old people. Tartar-emetic, ipecacuanha, aconite and veratrum viride are the articles generally employed.

Diaphoretics promote the secretion from the skin, and exert a beneficial effect by restoring or altering the character of the perspiration, which may have been temporarily checked or suppressed under the influence of the inflammation. The articles employed

in this extensive class—sometimes together with tepid drinks—are ipecacuanha, Dover's powder, tartar-emetic, sweet spirits of nitre, a solution of acetate of ammonium, and the external use of the warm bath or the warm foot-bath.

Diuretics, remedies which exert their action on the urinary secretion, are sometimes prescribed as antiphlogistics, but never in inflammatory conditions of the urinary organs. Nitrate of potash, bitartrate of potash or cream of tartar, squills, colchicum, and many other agents of this class, are employed.

The *local antiphlogistic treatment* includes a variety of external applications, such as bathing, fomentations, poultices, etc.; iodine, nitrate of silver or lunar-caustic, blisters, etc.; and local blood-letting by cups, leeches, etc. All of these remedial measures will be described elsewhere.

Antiseptics and Antiferments.

Antiseptics (αντι, "against," and σηπτος, "putrid") are substances which retard or prevent putrefaction. They must not be confounded with *disinfectants*, which are frequently only odor-destroyers, although many of the antiseptics belong to both classes. They are not necessarily of a chemical nature, for cold, a vacuum, a condition of dryness or freedom from moisture, are physical agents operating to check putrefaction. The list of chemical antiseptics is becoming larger with the increased knowledge and discoveries of the day. The principal articles are chlorine, carbolic acid, salicylic acid, nitrous and sulphurous acids, the sulphites of sodium, potassium, etc.; alum, carbolates and sulphocarbolates of sodium, potassium, etc.; tar, chloride of zinc, creasote, sulphate of iron, etc. Antiseptics sometimes unite with elements present in the organic matter only to form new compounds; some of them merely abstract the water from it, or, in addition, form new compounds. Some take the oxygen from it, while others exert their destructive influence on the living matter that may be present. The precise benefit to be derived from the employment of antiseptics has not been so accurately determined as to lead to their use under all circumstances, with confidence in their undoubted efficacy.

Antiferments.—These are remedies which are intended to check or destroy processes of fermentation. It has for some time been a matter of interesting speculation as to the essential conditions which inevitably lead to these phenomena of fermentation in the human body. It seems to be pretty well determined by investigation that minute living organisms, variously called bacteria,

microzymes, etc., cause the production of such a result, or are in some way connected with it. They have been seen, for instance, in the microscopic examination of diphtheria and other fermentative inflammatory conditions. Antiferments either destroy these living germs, and thus become valuable agents in the special affections to which they are applicable, or they arrest the process of fermentation, of which they are the cause and origin. The class of *antiseptics* is sometimes described as synonymous with that now under consideration ; whatever difference there may be between them is explainable on the different interpretation that may be placed on the nature of the two processes involved—putrefaction and fermentation. [See chapter on Acute Infectious Diseases.]

Remedies which Influence the Functions of Vital Organs.

One of the curious phenomena associated with the internal administration of medicines is the predilection exercised by them towards certain organs. It is undeniable that some strong affinity exists between many of the articles of the materia medica and various important parts of the system, which is not easily explicable. In illustration of this fact, we find the action of strychnia exerted specially upon the spinal cord ; digitalis displaying its potent influence upon the heart and kidneys ; iodine devoting its energies to the lymphatic system, stimulating the absorbents to renewed activity, and producing in this way an alterative effect ; belladonna acting upon the vaso-motor ganglia, and producing, by its influence upon the nerves of the iris, dilatation of the pupil ; nitrite of amyl, inducing flushing of the face by dilatation of the capillary arteries in consequence of paralysis of the muscular layer of these vessels, etc. The list might be extended to a much greater length, to include other familiar agents—the bromides, for instance, which depress the action of the heart and respiration, as well as the temperature, a result of their sedative action on the sympathetic system of nerves,—but the illustrations already given are sufficient to show the existence of the elective affinity already alluded to. Several medicinal agents act by preference on the nervous system, but in a different way. Opium, for example, causes stupor by its action on the brain ; while both the brain and spinal cord are affected by strychnia, tetanic convulsions resulting from excessive doses. Some remedies show their peculiar affinity, no matter by what channel they may be administered ; rhubarb, for example, purging, whether given by the mouth or in any other way, and tartar-emetic inducing vomiting.

Electricity and Magnetism.

The peculiar excitant effect of these potent agents has long been familiar to the medical practitioner. The relation of electricity, in its various forms, to disease, is known as electro-therapy or electro-therapeutics. When simple electricity was alone employed—before galvanism (chemical electricity) or Faradization (inductive electricity) was known—its medical uses were restricted to the employment of the electric bath and the communication of shocks from the Leyden jar. A writer of the last century speaks of electricity as then used—and the description is good for all time as applicable to all the forms now in vogue—as "a remedy of vast and varied powers, possessing a more powerful influence over nutrition, equalizing the circulation, materially affecting the pulse, the perspiration and the secretions." The machines in use at the present day are generally illustrations of induced electricity, and are much more powerful and convenient for manipulation than the other forms. The usual modes of exhibiting electricity for medical purposes are by localized and general Faradization. and localized and central Galvanization ; electricity proper not being employed. Galvanism, or Voltaic electricity, and Faradization, or induced electricity, are examples of current or dynamic electricity, or electricity in motion. The Voltaic or Galvanic current—depending usually on the mutual action of acid and metals—is sometimes called the primary, constant, or direct current ; the Faradic current is also called the secondary, induced, interrupted, electro-magnetic and magneto-electric current, according as the current is induced, in the two last, through the action of the magnet or chemical agency. The Faradic batteries are single or continuous, and double or separate coil machines, and it has been found by some of the best electricians that the current proceeding from the single coil is preferable in the treatment of nervous patients and for general tonic influences, while the separate coil is more adapted to those cases which are attended with loss of sensation and of contractile power of the muscles.

It will not be necessary here to enter into the details of the action of electricity upon the nerves and muscles, the great centres of the nervous system and the organs of the senses, and in modifying the nutritive functions. Briefly it may be said that the nerve current is diminished or strengthened by the relative direction of the electric current or by the interruption, closing or reversing of the same. So far as the brain is concerned, it is difficult or nearly impossible to produce any marked effect on the centres of

voluntary motion through the application of electricity. It can be readily understood that it is sometimes a matter of extreme nicety to so localize the seat of a disease of the brain as to be able to make a direct application of this remedy to the part affected. The spinal cord can be more readily influenced by these external applications, and through it the muscles of the trunk and of the extremities and the important organs supplied directly by the spinal nerves or their communications with the sympathetic nerve. Experiments have shown that when applied directly to the sympathetic nerve or its ganglia, electricity contracts the small arterial vessels, by its influence on what are called the vaso-motor nerves. The action of the heart is augmented by the application of galvanic electricity to some of the nerve-centres of the neck and chest, while the worm-like movement of the intestines is diminished or increased, according to the strength or mildness of the current employed. When applied on the living subject, however, the effect is not so apparent, the main results achieved being the production of a general sensation of warmth and sleepiness—sometimes deep sleep—with perspiration. On the organs of special sense, the effect is to excite and intensify the sensations of each, and the therapeutic use of electricity in these cases may therefore be inferred from the influence thus exerted. In affections of these delicate organs, however, and indeed in diseases generally, in which this powerful agency would seem to be indicated, the advice of the physician should always be obtained, with the view of procuring intelligent directions for its use, or for its adaptability to the special morbid condition.

Electricity may be applied to muscles, eith r directly in their course or through the nerves which supply them. Any one who has a sufficient knowledge of the anatomical relations of parts will soon make himself familiar with the appropriate points at which these applications may be made. The various important organs, such as the intestines, heart, uterus, bladder, stomach, etc., are all supplied, in greater or less degree, with a muscular organization, not under control of the will, and the excitant effect of electricity, in some appropriate shape, may be readily employed to produce contractions that will relieve constipation, paralysis of the bladder, engorgement of the uterus, and numerous other morbid conditions of those organs. The nutritive functions of the body are improved by the tonic and stimulant action of electricity, the powers of the absorbent vessels being excited, and the secretions modified according to the degree to which the application is carried.

RICHARD J. DUNGLISON, M.D.

MINERAL SPRINGS.

BY

GEORGE E. WALTON, A.M., M.D.,

OF CINCINNATI, OHIO,

PROFESSOR OF PRINCIPLES AND PRACTICE OF MEDICINE IN THE CINCINNATI COLLEGE OF MEDICINE AND SURGERY; MEMBER OF THE SOCIÉTÉ FRANÇAISE D'HYGIÈNE, PARIS; AUTHOR OF "THE MINERAL SPRINGS OF THE UNITED STATES AND CANADA," ETC., ETC.

MINERAL SPRINGS.

A HALO of mystery surrounds all medicines. They are supposed by many to produce their effects in an occult manner, and in the olden time even the place or juxtaposition of stars was thought to exercise in some peculiar way a potent influence.

Around no subject associated with medicine do these vapors and mists of the dark ages cling more closely than that of mineral waters. Vapors and mists they appear to us, but poetry and religion they were to those who lived two thousand years ago. Spirits and divinities frequented the fountains, and their whispered voices were heard in the surrounding groves, as they swayed to the breeze. Sometimes the springs were near the cities, but more frequently in distant and unfrequented places. Their polished white marble columns supported an overarching dome, which might be seen from a distance shining out amidst the verdure of the trees as the weary invalid approached. Near by there was frequently a temple of the same pure white marble, with long lines of steps ascending to columned porticos, while within, the virgins kept constant guard over the sacred fires. Such was the fountain of Cassotis, at Delphi, in Greece. To such places the afflicted were borne by their friends, and placed near the mysterious spring. They drank of the divine waters and were bathed, and, after their cure, left votive tablets commemorative of the virtue of the water and the goodness of the gods. Now we have dismissed the divinities, whitewashed boarding-houses are the temples, and yellow pamphlets containing certificates of miraculous cures are the votive marbles. Still we cling to the mysteries, and those who discover new medicinal springs frequently imagine they have found something previously unknown and unknowable —a water flowing from a remote corner in the caverns of the earth, bearing untold blessings for the afflicted, and only incidentally profits for the proprietor's pocket. Let us cast all this aside!

Mineral waters are subject to the same rules as other chemical combinations; they contain ingredients in varying proportion—

nearly all of which are already well known—combined, it is true, in a more perfect manner than is known to the arts of the laboratory. They vary in medicinal value, as do other medicines, and for similar reasons. Let us remember that nearly all springs in this country are but repetitions of those known beyond the Atlantic ; that their value in various diseases has been clearly defined, and that, as a rule, we have only to consult an accurate analysis of a water to determine with considerable certainty in what diseases it will prove beneficial. In other words, the entire subject of composition, administration, and cure, by mineral waters, is subject to tolerably well-ascertained laws. Let us then succinctly review the present state of our knowledge in this matter. First, as to

COMPOSITION.

All waters flowing from the earth or upon the earth are mineralized waters in an absolute sense, containing mineral substances in greater or less proportion, though not always sufficient to entitle them to that name in the medical signification. The waters of the sea are highly mineralized, and the waters of many rivers are sufficiently so to produce decided effects—some causing diarrhœa, others constipation, as will be affirmed by those who have travelled much in various lands and drank of different waters. Rain-water is nearer pure water than any other form found in nature ; chemically pure water is a result of laborious processes of the laboratory, and is procured and retained with difficulty.

When this comparatively pure rain-water (containing minute quantities of nitrogen, oxygen, and carbonic acid, and sometimes traces of carburetted hydrogen, nitric acid, and ammonia) falls on the earth, it immediately, by its solvent action, separates from the soil its soluble mineral constituents, and the farther it flows the more decidedly is it impregnated with them, in exact proportion to the quantity in the earth over which it passes. When the water, instead of coursing along the surface, sinks deep down, penetrating indurate rocks, it will, when it reappears, bear with it tokens of its dark subterranean journey.

What are the most frequent chemical ingredients of mineral waters ?

Chloride of sodium (table salt), carbonate of sodium, sulphate of lime (gypsum), sulphate of sodium (Glauber's salt), sulphate of magnesium (Epsom salt), iodide of sodium, carbonate of iron, carbonic acid gas, sulphuretted hydrogen gas, oxygen and nitrogen. The unusual ingredients are bromide of sodium, arsenical salts,

fluorides, organic compounds—such as hydrosin and free sulphuric acid.

CLASSIFICATION.

Since almost all mineral waters contain some one ingredient far in excess of every other, it becomes easy to formulate a classification based on this fact, and thus we have: I. Alkaline waters (alkaline carbonates in excess). II. Saline waters (chloride of sodium in excess). III. Sulphur waters, so named from the presence of sulphuretted hydrogen gas. IV. Chalybeate waters (some salt of iron prominent). V. Purgative waters (sulphate of sodium or other purging salt in excess). VI. Calcic waters (carbonate or other salt of lime prominent). VII. Thermal waters, characterized by high temperature.

A classification of this kind is especially valuable as an aid in the administration of mineral waters for the cure of disease. It has been well determined by observation, both in this country and in Europe, that the waters of each of these classes possess properties peculiar to themselves for the relief of various maladies; and, although in some special characteristic the waters of separate classes may resemble each other, yet in their ultimate effects they are quite distinct.

It becomes desirable, then, to name the prominent springs in this country and in Europe pertaining to each class, together with a condensed statement of their chemical constitution and therapeutic action. To name *all* in this chapter, or give detailed analyses will be impossible, since there are over two hundred and fifty medicinal mineral springs in the United States alone, more or less famed for their curative virtues, and surrounded by all the appurtenances of hotels, bath-houses, drinking-fountains, etc.

Alkaline Waters.

The special characteristic of these waters is that the alkaline carbonates of sodium, potassium, and magnesium, are the principal ingredients.

The most noted alkaline springs of the world are those of *Vichy*, France, containing twenty-six grains of carbonate of sodium, two grains of carbonate of potassium, one grain of carbonate of magnesium, and fourteen cubic inches of carbonic acid gas in each pint of water. There are several springs at Vichy—the Grande Grille, Célestins, Chomel, Mesdames, etc.—the waters of which are bottled and may be found in the principal cities of the world. The waters of *Hauterive* and *Cusset-Vichy*, a few miles distant, are of the same

character. In Germany there are the springs of *Fachingen* and *Ems*, also decidedly alkaline waters. The only spring in this country which represents this class is that of *Bladon*, in Alabama, containing five grains of carbonate of sodium in the pint.

Uses.—The diseases to which these waters are applicable are uric acid gravel, gout, catarrh of the stomach (chronic gastritis), diabetes (mellitus), and gall-stones.

Saline Waters.

The prominent constituent of these waters is chloride of sodium (table salt). It must, however, be remembered, that in different springs there are various other constituents which modify or reenforce the action of this agent so as to produce an effect entirely distinct from that of an ordinary solution of salt. The waters of this class increase the action of the intestines, and prove aperient or cathartic according to their concentration and the quantity taken. They also promote the flow of urine and the secretion from mucous membranes. They stimulate digestion, augment the flow of bile, and exercise a marked influence over the processes of change in the lymphatic system.

The mild saline waters, containing considerable carbonic acid gas and a small proportion of alkaline salts, are the most agreeable to the taste of all mineral waters. The famous table mineral waters—*Selters* and *Apollinaris*—which blend so well with wine, belong to this division. In this country we have the unsurpassed *Saratoga* waters. They contain in each pint from thirty to sixty grains of common salt, from five to fifteen grains of the alkaline carbonates, and a like proportion of carbonate of lime, with small quantities of sulphates, iodides, and bromides. There are about twenty different springs at Saratoga, all rivals for popular approbation, and each proprietor claims superior excellence for his own ; while the water of the springs vary somewhat in the amount of each ingredient, they possess similar medicinal properties. An exception should be made as to the "Columbian," "Pavilion," and "Hamilton" springs, each of which contain an active proportion of carbonate of iron.

We have not mentioned above an ingredient of the water which contributes largely to its popularity and efficacy—that is, carbonic acid gas, which is present in the proportion of thirty to sixty cubic inches per pint ; indeed, the quantity is so large in the "Geyser" and "Spouting" springs, that the water is forced many feet into the air by its pressure. Only a few miles distant from Saratoga is the village of *Ballston*, where there are several springs

identical in character and medicinal effect with those just mentioned.

Other saline waters in the United States, which may be used internally, are those of the *Charleston Artesian Well*, S. C. (nine grains chloride of sodium and seven grains of carbonate of sodium per pint), and *Albany Artesian Well*, N. Y. (sixty-three grains of chloride of sodium, seven grains of alkaline carbonates, and twenty-eight cubic inches of carbonic acid gas per pint).

Uses.—The *stronger saline waters* are used both internally and in the way of baths, the latter mode of administration being almost restricted to the very strong saline waters—brines—known and highly favored in Germany as "sool-baeder." These natural earth-brine baths prove of exceeding service in the treatment of scrofula, especially as it manifests itself during childhood. They are also beneficial in chronic rheumatism and chronic gout, when the person is anæmic or of pallid hue. Paraplegia or paralysis of the lower limbs, and hemiplegia or paralysis of one side of the body, are frequently benefited in a marked manner by the stimulant action of these baths on the skin, nerves, and blood-vessels, when resort to them has not been too long delayed. The use of these baths in cases of paralysis does not in any way contravene the additional employment of other remedies best known to physicians, and which require skill and judgment in their use.

The *mild saline waters*, taken internally, are valuable in various morbid conditions of the liver. Jaundice due to catarrh of the bile-ducts is relieved by them, and the formation of gall-stones prevented. That condition known as engorgement of the liver and abdominal plethora, occurring in persons of full habit, is also favorably influenced by their use.

Sulphur Waters.

Sulphur Waters are so called because of the presence of considerable sulphuretted hydrogen—a gas of peculiarly fetid odor—exceedingly disagreeable to the taste of some persons, but becoming, after a time, not only tolerable, but pleasant. Aside from this gas, these waters contain exceedingly variable ingredients, which, if they alone were considered, would, by their predominance, assign some of the springs to another class. Thus, we have alkaline sulphur waters, in which the alkaline carbonates are abundant, muriated sulphur waters which contain considerable chloride of sodium, and calcic sulphur waters which are impregnated with salts of lime.

Sulphuretted hydrogen, as taken into the stomach in moderate

quantities in mineral waters, increases the activity of the intestines and augments the perspiration. The sulphur contained in it permeates the tissues and blood-vessels in a peculiar manner, and there induces nutritive changes usually termed "alterative." Although this gas thus exercises a decided influence in the cure of diseases, especially those of the skin and mucous membranes, yet in the prescription of these waters special attention should always be given to the amount and properties of the solid ingredients. Certain sulphur waters are designated as "white," "blue," "yellow," or "red," according to their color. This depends on the deposits which occur after the water has escaped from its source. In white sulphur water the precipitate is sulphur; in yellow, it is polysulphurets; in blue, it is supposed to be an impalpable powder of slate; and in the red, a deposit of oxide of iron, or the development of microscopic algæ of a red hue, is presumed to be the cause. In some waters of this class a peculiar organic substance is found, called hydrosin or barégine, which seems to give to these waters a sedative or quieting effect on the circulation of the blood. Its exact medicinal value has not, however, been determined.

In this country, as in all others, there is a long list of sulphur waters. Indeed, when we consider the small quantity of sulphuretted hydrogen necessary to impart to water its characteristic odor, and that it is frequently evolved by the decomposition of organic substances on the surface of the earth, we need not be surprised that in nearly every valley there flows a so-called sulphur-spring. Such waters are, however, seldom medicinal, and, aside from their peculiar odor, possess no other qualities than ordinary water.

Of muriated sulphur waters, or those in which chloride of sodium is a prominent constituent, we have several valuable ones. Such are the *Upper* and *Lower Blue Lick*, the *Paroquet* and *Louisville Artesian*—all in Kentucky; also the *Columbia*, in New York, each containing from thirty to sixty grains of salt in the pint. There are also springs which, in addition to common salt, contain an active proportion of purgative salts, like the *French Lick*, in Indiana; or they contain purgative salts with lime salts, like *Sharon*, New York; *Greenbrier White Sulphur*, Virginia; and *Salt Sulphur*, West Virginia. Again there are sulphur waters in which the salts of lime alone predominate, as *Chittenango* and *Clifton*, New York, or the *Yellow Sulphur*, Virginia. Occasionally there is a water found containing an active proportion of alkaline, saline, and purgative salts. Such is the *Borland Spring* of West Virginia. Least frequent of all are waters containing hydrosin, like the *Red Sulphur*, West Virginia—a water the peculiar properties of which seem to

depend entirely on this constituent. Of thermal sulphur waters, there are the *Calistoga*, *Paso Robles*, and *Santa Barbara*, California; *Middle Park*, Colorado; and *Warm Springs*, North Carolina.

The principal cold sulphur waters of Europe are those of *Nenndorf* and *Meinberg*, Germany; and the most noted thermal sulphur waters are *Aix-la-Chapelle*, Belgium; *Aix-les-Bains*, Savoy; *Baréges* and *Bagnères de Luchon*, France.

Uses.—Sulphur waters are valuable in the treatment of gout and chronic rheumatism, especially if they are warm waters; and it is probable that in these diseases they cause favorable results as much by this element of heat as by the solid ingredients. In chronic poisoning by lead, from which painters so often suffer, and in chronic poisoning by other metals, sulphur waters used internally prove exceedingly beneficial, the sulphur forming soluble salts with the metal, which then are eliminated through the skin and kidneys.

Chalybeate Waters.

Iron is the principal constituent of these waters. It is usually present in the form of a bicarbonate, and those waters are most easily digested which contain considerable carbonic acid gas. In this way iron enters the blood more readily and exerts its tonic influence more certainly than in almost any other.

The number of good iron springs in this country or Europe is exceedingly limited. Why this is so is readily understood when we consider the requisites, viz.: First, the water must contain sufficient iron to be decidedly medicinal. Second, it must contain considerable carbonic acid gas. Third, there must be very little of other constituents. A popular spring of this kind is that of *Schooley's Mountain*, New Jersey, which is said to be a pure chalybeate. *Cooper's Well*, Mississippi, has enjoyed much repute in the South for many years. It contains nearly half a grain of iron in each pint, with salts of lime, magnesium and sodium. *Rawley Spring*, Virginia, is a good chalybeate. The best chalybeates in Europe are those of *Schwalbach* and *Pyrmont*, containing respectively one-half and two-thirds of a grain of carbonate of iron per pint.

The *Alum Waters* of Virginia are included under chalybeates, although they are not such in the sense of pure iron tonics. They are really alterative waters of a peculiar and complex character. They contain from half a grain to a grain of iron in each pint, together with considerable alumina and free sulphuric acid. They have been found especially valuable in scrofula and diseases of the skin depending on a scrofulous constitution. The principal springs

of this kind are the *Rockbridge, Jordan, Bath,* and *Bedford-Alum*—all in Virginia.

Uses.—The effect of these waters is to increase the appetite, promote digestion, stimulate the activity of the heart, and, when persons are blanched (anæmic), they add to the blood the iron which has disappeared, and bring back the rose-hue to the cheeks.

Waters of this kind are useful in all cases of impoverished blood, whether depending on dyspepsia, derangement of menstruation, exhausting diseases, or any cause whatsoever. They are also frequently resorted to by persons who have undergone, at other springs, a course of reducing treatment with alterative mineral waters. When, at the close, the person is relieved of his malady, though pale and anæmic, he may go to some good chalybeate spring, drink the water for one or two weeks, and be restored to accustomed vigor.

Purgative Waters.

These waters, as the name implies, contain constituents which cause them to act as cathartics or aperients. These effects are more or less pronounced according to the preponderance of sulphate of magnesium (Epsom salt), sulphate of sodium (Glauber's salt), or sulphate of potassium, and the way in which they are associated with other ingredients, such as the alkaline carbonates, sulphate or carbonate of lime, or some salt of iron, either of which tends decidedly to modify their action. These waters are bitterish in taste, and by the Germans are termed "*bitter wasser.*" This taste is, however, decidedly mitigated by the presence of considerable carbonic acid gas.

The principal purgative springs of this country (the *Crab Orchard*) are located in Kentucky. They contain thirty-three grains of purgative salts in each pint. By boiling down the water a valuable purging salt, known as *Crab Orchard Salts*, is obtained. There are also the *Estill* springs, containing thirty-two grains of purgatives per pint, and the *Harrodsburg Springs,* containing twenty grains of purgative salt per pint. Both are situated in Kentucky. The only other purgative spring of note is that of *Bedford*, Pennsylvania, which, however, is, as a rule, aperient only, because of the considerable amount of carbonate of iron which it contains.

The European purgative waters most frequently for sale in bottles at the pharmacies are *Friedrichshall* (eighty-six grains of purging salts to the pint) ; *Kissingen* (eighty-five grains), *Pullna* (two hundred and twenty grains), and *Hunyadi Jānos* (two hundred and sixty-six grains). The last-named—the Hunyadi Jānos

—is doubtless the best of these waters; containing a large amount of purging salts. In addition there is considerable carbonate of sodium, chloride of sodium, and carbonate of lime, which tend to render its action mild.

Uses.—These waters are mostly used as substitutes for the disagreeable-tasting saline purgatives of the shops; and although containing the same purging salts, yet these are so combined with other ingredients that they act more mildly, and the taste is but little noticed. Persons do not go to the spring to drink this sort of water, but it is bottled, and under the proper name may be found in nearly all the pharmacies of the larger cities.

These waters are sometimes used in that condition known under the somewhat vague name of abdominal plethora. This occurs most frequently in persons who are generous livers, and use malt liquors and wine frequently. It is associated with constipation, a loaded tongue, and sluggish action of the liver. In such cases a short course of these waters frequently relieves all the symptoms in a short time, and reduces the previously corpulent person to a normal weight.

Calcic Waters.

The principal ingredients of these waters, as the name implies, are salts of lime.

The most prominent springs of this class in the United States are *Eaton Rapids*, Michigan, containing five grains of lime salts and two cubic inches of carbonic acid gas in each pint; *Sweet Springs*, Virginia, containing five grains of lime salts and eleven cubic inches of carbonic acid gas; and *Bethesda*, Wisconsin, having two grains of lime salts in each pint. The last-named spring has a widespread reputation for the relief of those diseases to which waters of this kind are applicable. The most esteemed calcic waters of Europe are *Contrexville* (twelve grains of lime salts to the pint), and *Wildungen* (three grains of lime salts and a large quantity of carbonic acid gas to each pint).

Uses.—Some time ago waters of this kind were thought to possess little value. It is, however, found that those containing carbonate of lime and alkaline carbonates, with considerable carbonic acid gas, are exceedingly valuable in irritability of the bladder depending on chronic inflammation, and also of gravel, either of the kidneys or bladder. They also prove palliative in cases of saccharine diabetes. Cases of dyspepsia, accompanied by pain, are also frequently relieved by their use.

Thermal Waters.

The chief agent in the curative action of these waters is heat, and the good results to be obtained by their use depend almost entirely on the appreciation of this fact and on its appropriate application. It is often asked, "Why not, then, use hot water at home?" For the simple reason that it is impossible to obtain hot water there in sufficient quantity and of continuous temperature. Imagine a person trying to imitate a single bath, such as may be had at the Hot Springs. For the purpose, hundreds of gallons of water must be heated to a temperature of 150° F., and it must be maintained in a reservoir at exactly that temperature. Then it must flow in a stream into and out of the bath-tub, so that the temperature of the water in the tub is kept at exactly the desired degree continuously—not vacillating from hot to cold and from cold to hot, as in an ordinary bath. Then, in addition, there must be a perfect mill-race of hot water to supply the vapor-room. The expense of heating so much water to such a degree, and the utter impracticability of retaining it there, is a sufficient answer to those who think lightly of thermal resorts.

It is said that a gentleman of Baltimore procured water of the Hot Springs, Arkansas, at great expense, and was surprised to find it did not have the desired effect in the bath at home. He and many others concluded the water had lost its peculiar properties during transportation, forgetting that he could not there reproduce the necessary thermal conditions—the even and continuous temperature, the douches and the vapor-bath. Still more is it impossible to imitate an immense warm "piscina" bath containing thousands of gallons of water, such as the one found at the Warm Springs, Va., and other noted resorts.

There are a number of valuable thermal springs in this country, but at few of them are the proper auxiliaries, piscina baths, douches, etc., such as could be desired. The *Hot Springs* of Arkansas (93° F.–150° F.), *Hot Springs*, Va. (78° F.–110° F.), and *Warm Springs*, Va. (98° F.), occupy a deservedly high place, though they are but slightly mineralized, and in Europe would be termed indifferent thermal waters. The *Warm Springs*, N. C. (97° F.–102° F.), contain sulphuretted hydrogen, carbonic acid, and sulphate of lime. The *Idaho Hot Springs* (85° F.–115° F.) contain three grains of carbonate of sodium, three grains of sulphate of sodium, and two grains of sulphate of magnesium to the pint. The *Paso Robles Hot Springs* of California (112° F.–122° F.) contain considerable chloride of sodium and carbonate of sodium,

and a large amount of sulphuretted hydrogen and carbonic acid gas.

The prominent thermals of Europe are *Gastein*, in Austria (87° F.–160° F.), *Toeplitz*, in Bohemia (120° F.), *Schlangenbad*, in Nassau (82° F.–89° F.), and *Plombières*, in France (125° F.).

Uses.—The diseases to which thermal baths and douches are specially applicable are chronic rheumatism, chronic gout, paralysis of the lower limbs (paraplegia), neuralgia, stiffness of the joints (false anchylosis), and certain diseases of the skin (psoriasis, lichen, etc.). In syphilis they promote cure by aiding appropriate internal medication.

DISEASES THAT MAY BE TREATED BY MINERAL WATERS.

Having thus considered the different classes of mineral waters and the diseases to which they are applicable, we will reverse the direction of view, and, from the various diseases, look towards the waters which are best adapted to their cure under varying conditions.

Chronic Rheumatism.—The mineral water treatment of this disease consists almost exclusively in the employment of thermal baths (95° F.–100° F.), thirty in succession, at intervals of one or two days, according to the effect. When there is decided stiffness of the joints, the hot douche (106° F.–120° F.) is a valuable auxiliary. It is for the most part indifferent whether these baths are of highly mineralized water or not. In some cases in which there is decided want of tone in the skin, the salt thermals seem preferable because of the decided stimulation of the skin which results from their use.

No one suffering from gout in any form, however, should go to mineral-water cures without consulting a competent physician, for, although mineral waters are one of the best and surest methods of treatment, yet the application of them is so varied according to the different stages of the disease, and the improper use of them may be attended by such disastrous results, that exceeding care must be taken in the adaptation of them to each particular case.

Syphilis.—There are no mineral waters that cure this malady; yet there are many, which, conjoined with the use of appropriate medicines, aid most decidedly in the removal of the diseased condition of the system. Sulphur waters, saline waters, thermal waters—all have been successfully used in this disease. Perhaps the best results have, in this country, been obtained at the Hot Springs of Arkansas, though we doubt not that other thermal baths, such as

the Virginia Hot Springs, and Paso Robles of California, would prove equally efficacious.

Chronic Metallic Poisoning.—The most frequent form under which this is presented is the paralysis of painters and workers in lead. The most efficacious are the sulphur waters, conjoined with the use of warm or hot baths.

Diabetes Mellitus, or that condition of the system in which sugar is passed in the urine in large quantities, is exceedingly difficult of cure. However, most decided benefit has resulted in many cases (see Volume II.) by the systematic use of alkaline or calcic waters, under competent direction.

Chronic Dysentery.—The so-called chronic diarrhœa of the army is slow to yield to the administration of remedies. Indeed, there are soldiers of the late war—now twelve years past—who are still harassed by the malady. It has been claimed, and doubtless with truth, that the alum waters of Virginia have cured a number of cases of this disease.

Scrofula.—This term is applied to a peculiar condition of the constitution, in which there is a disposition to enlargements and abscesses of the lymphatic glands, to slow-healing ulcers, to certain skin diseases with a moist secretion, and to chronic inflammations of the joints. (See Volume II.) For the relief of this bad habit of the body, especially in young children, next to cod-liver oil, there is nothing superior to an appropriate mineral water, and it is frequently desirable to alternate mineral water treatment with cod-liver oil. The waters most applicable in these cases are the strong salines used in the way of brine-baths, and it is this kind of waters that are almost exclusively employed abroad. We have, however, in the Virginia alum waters, a sort little known in Europe, and these have long had considerable reputation for the cure of scrofulous diseases.

Chlorosis, or "green sickness," as it is sometimes popularly called, affects especially young girls on the verge of womanhood. They are languid, pale, with a greenish tint of skin, and the functions of maturity do not readily become established. Chalybeate waters are a valuable remedy in this condition, when associated with other and appropriate medicines.

Paralysis.—Certain cases of paralysis following exhausting diseases, such as diphtheria, typhoid, and cerebro-spinal fever, tedious confinement, etc., are often much benefited by proper use of thermal baths and douches ; but graver cases, in which pronounced changes have taken place in the tissues composing the nervous system, are rarely benefited.

Neuralgias.—These painful affections, when due to local irrita-

tion of nerves and nerve-sheaths, are sometimes cured in an unexpected manner by the use of thermal baths or douches ; thus, it is often serviceable in cases of *sciatica* of long standing. It is, however, very difficult to decide in advance which cases will be benefited, and a trial of the waters is the only test.

Chronic Laryngitis, also popularly termed "clergyman's sore throat," although by no means restricted to that profession, is a tolerably frequent disease, especially in large cities. The prominent symptoms of the disease are dryness of the throat on rising in the morning, which is, however, considerably relieved after a good meal, and there may then be coughing and expectoration of thick, tenacious, starchy-looking mucus, which clings to anything it falls upon. The voice loses its clear quality, and is hoarse, especially towards evening and if the air be damp. Talking fatigues the person very easily, and there is a tired feeling about the throat.

In the treatment of this malady, mineral waters prove efficient in many cases. The waters most appropriate are those of the sulphur class, rich in sodium, and alkaline waters containing a great deal of chloride of sodium. The European waters which have acquired the most decided reputation are Ems, in Germany, and Eaux Bonnes, France. The water in this country which will probably yield the best result is that of the Red Sulphur Spring of Virginia.

Chronic Bronchitis is a frequent disease, especially among persons advanced in years. It is often mistaken for consumption by those who are not physicians, and, when cured, the medicines given, or the waters taken are, credited with curing consumption. One of the most reliable waters in this disease is the Red Sulphur, of Virginia. If the patient is of a scrofulous constitution, then the saline sulphur waters are preferable.

Dyspepsia.—This word, meaning painful digestion, is applied to a number of conditions in which this is a prominent symptom. In that form of the disease called acid dyspepsia, the alkaline mineral waters prove of especial utility. When the case is one of flatulent dyspepsia, and is attended with the evolution and belching up of large quantities of gas, the saline waters yield the best results.

The Saratoga waters, containing considerable chloride of sodium, and sufficient alkaline carbonates, are well adapted to most persons troubled with this malady.

Chronic Gastric Catarrh.—This may be called a form of dyspepsia in which the internal coats of the stomach are in a congested and inflamed state, and there is an exaggerated secretion from the mucous membrane. For its treatment the strong alka-

line waters, like Vichy, are mostly employed, and prove exceedingly beneficial. Alkaline purgative waters, such as Carlsbad and Marienbad, are also curative.

Constipation.—It is popularly well known that one of the best remedies for this condition is the ingestion of a glass of ordinary water immediately on rising in the morning. Much more is it the fact if an appropriate, mildly-aperient mineral water be used. The water tends to increase the secretion of the mucous membrane of the intestines and augment their expulsive action. For this purpose Saratoga or Blue Lick water is exceedingly appropriate, while in some instances mild purgative waters, such as Carlsbad, may be employed.

Engorged Liver.—Persons who suffer from this condition present a dusky or muddy complexion, the tongue is coated, the bowels are constipated, the appetite is variable, there is a pasty taste in the mouth, and a feeling of fulness in the head. Besides, the persons suffering therefrom are usually fond of the pleasures of the table, portly in appearance, and lead sedentary lives. For the relief of this malady there is no remedy superior to an appropriate mineral water. For this purpose a saline sulphur water may be used, or an alkaline purgative water; and either will, as a rule, give very beneficial results in a short time.

Gall-Stones.—The formation of these concretions in the gall-bladder seems to be due to a sort of thickening of the bile. For the relief of this condition, and hence, for the removal and prevention of gall-stones, there is no remedy equal to a good, strong, alkaline mineral water like that of Vichy. Carlsbad, an alkaline purgative, and Saratoga, of the alkaline-saline class, will also yield satisfactory results.

Gravel.—The kinds of gravel most frequently met with are uric acid or red gravel, oxalic acid gravel, and phosphatic gravel (see Volume II.) For the relief of uric acid and oxalic acid gravel, alkaline water should be employed, like that of Vichy or some similar water. In cases of phosphatic gravel, the calcic waters rich in carbonic acid gas should be given.

Calculus, or stone in the bladder, is a result of the aggregation of gravel into a solid mass or stone. It is, like gravel, divided into different kinds, and the same waters should be given accordingly. It should, however, be remembered that no kind of mineral water will dissolve stone. The treatment, therefore, is by the surgical operation of lithotomy or lithotrity, after which an appropriate mineral water tends to prevent a renewal of the trouble.

Catarrh of the bladder, resulting from chronic inflammation of the mucous membrane, is often relieved in a marked manner by

the use of mineral water. The kinds most appropriate are the mild calcic or alkaline waters.

Dysmenorrhœa, or painful menstruation, depending on plethora of the system, *i. e.*, uterine engorgement, is often benefited or cured by the internal administration of mineral water. That which proves most serviceable in these cases is alkaline water of moderate strength, or an alkaline-saline water; although water of some of the other kinds will frequently produce a favorable result. It should be remembered that dysmenorrhœa arising from any other cause will not be relieved by mineral water.

Diseases of the Skin.—There is an infinite variety of skin diseases buried under sesquipedalian names, but they can all be ranged under a few classes. [See chapter on the Skin and Hair]. The specially "dartrous" diseases are lichen, psoriasis, and pityriasis, each being of a dry, scaly character, without any moisture or discharge; the first two causing a thickening, roughness and redness of the skin. The principal mineral water treatment of lichen and psoriasis is by warm baths and the internal adminis-tion of saline sulphur water. The baths seem to act all the better if they be of thermal sulphur water. Baths are frequently continued for a long time in these diseases, until a bath-eruption, called by the French *la poussée*, is produced. The baths are then discontinued, and when this artificial eruption disappears, so does the original—never to reappear. In pityriasis, baths of sulphur water, and the internal use of it, are the remedy. For scrofulous skin diseases the saline and saline sulphur waters are used. In syphilitic skin diseases the baths and internal use of the waters are only adjuncts to appropriate internal medication, which they re-enforce and render curative, often in a most remarkable manner.

Contractions of muscles and stiffness of joints, when not associated with organic changes and adhesions of bone, are frequently relieved by a well-directed course of thermal baths and douches.

Old Wounds.—In some instances, after a wound has healed, it reopens, closes, and opens again. This may be due to a retained piece of ball or shell, to a fragment of clothing or a splinter of broken bone. Under such conditions a series of thermal baths and douches often produces excellent results. A free suppuration is caused about the seat of the foreign substance, it becomes loosened, finds its way to the surface, is discharged, and the wound then heals permanently. It is for cases of this kind, and for cases of decay of bone, paralysis, rheumatic contraction, etc., that the military establishments of France, Germany, and Austria have special hospitals at some of the famous thermal springs.

Miscellaneous Observations.

In selecting a *place of resort*, we should remember that, in addition to the proper medicinal water, the advantages of location, society, etc., should be considered. The place should be elevated, so as to be free from malaria and noxious vapors, and possess a cool summer temperature. The sanitary conditions of the hotel should be unexceptionable, a subject too little regarded by many hotel proprietors. The society should be agreeable; for some it is better that gayety abound, for others that there be quiet.

The usual *season* at the springs commences from the 1st to the 15th of June, and closes the 1st of October. During this time all resorts are open to visitors. A few, however, are prepared to entertain guests throughout the year.

The rules for *drinking the water* are comparatively simple. The water should always be taken on an empty stomach, and about an hour should elapse before a meal. The usual way is to repair to the spring on first rising, and there to drink slowly a glass of the water, then promenade for fifteen minutes, then take another glass, and promenade again; then, in some instances, and of some waters, another glass may be taken. The exact quantity cannot be given, as that will vary according to the strength of the water and the peculiarities of the disease. One thing is always to be remembered —never to deluge the stomach with large quantities of the water, or make experiments as to how large a quantity can be drank. When a mineral water is being used, the patient should eat sparingly of good, wholesome food; but all pastries, highly seasoned sauces, etc., should be avoided. Frequently it is exceedingly difficult to limit one's self to plain fare, especially as the change of place, mountain air, and mineral water increase the appetite in a marked degree; but abstinence is an imperative necessity, if one is to obtain the full benefit of the waters.

The length of *time required for a course* of mineral waters is not definite, varying according to the malady and the peculiarity of the water. From three to four weeks may, however, be named as an average.

Invalids visiting springs should use much care in taking the water—should acquire all the information possible as to its action, and, as a rule, consult the resident physician before using it.

GEORGE E. WALTON, M.D.

OBSTETRICS; OR, THE ART OF MIDWIFERY.

BY

THEOPHILUS PARVIN, A.M., M.D., LL.D.,

OF INDIANAPOLIS, IND.,

FELLOW OF THE AMERICAN GYNECOLOGICAL SOCIETY; CORRESPONDING FELLOW OF THE BOSTON GYNECOLOGICAL SOCIETY, AND OF THE PHILADELPHIA OBSTETRICAL SOCIETY, ETC., ETC.

OBSTETRICS.

UNDER this head will be considered not only the process of labor, its disorders, and its management, but also the condition of woman during the nine months which precede parturition, and during the few weeks which follow, with the chief diseases incident to these periods.

Human pregnancy is the state of woman bearing within her the product of conception. Conception marks its commencement, labor its termination; between these it is included. The duration of pregnancy is generally considered as nine calendar or ten lunar months, and various tables have been given by which to determine the date of confinement. The simplest and most reliable rule is to count two hundred and seventy-eight days from the last day of the last menstruation.

Conception is that process from which a new being results—it is a reproduction.

In the human race reproduction is sexual—that is to say, two elements, the one contributed by the male, the other by the female, combine to form a new existence. Let us briefly consider the element which woman contributes. It is an ovule, a little egg, a round body, only the one hundred and eightieth of an inch in diameter. This ovule is the product of an organ known as the ovary, an almond-shaped body; woman has two of them, one on either side of the womb and directly connected with it anatomically as it is physiologically.

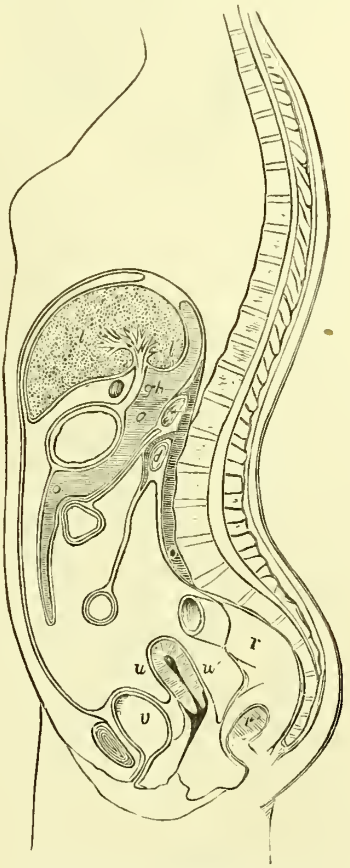


FIGURE 188. — Relations of the uterus to the surrounding organs: *u*, uterus; *v*, bladder; *u'*, pouch of the peritoneal lining of the abdomen, extending downward between the uterus and vagina, and the rectum (*r*).

In the illustration on the opposite page of what are called the internal organs of generation, the uterus, marked *a b c*, is in the centre, and an ovary, *i*, on each side.

Above each ovary is placed the oviduct or Fallopian tube, *g*, which, at its external end, is expanded, and has what is called a fringed border, *h*. One of the uses of this oviduct, as the name implies, is the conveyance of the ovum, or human egg, to the cavity of the womb.

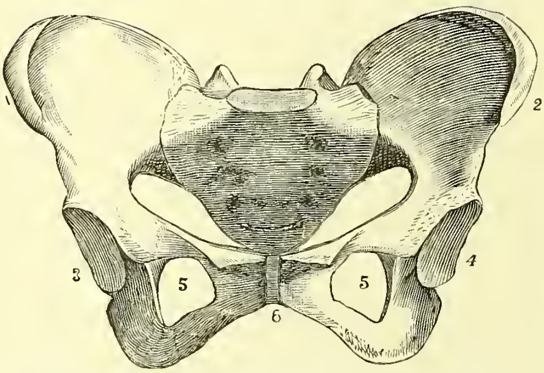


FIGURE 189.—The female pelvis, as seen from in front. 1, 2, the wings of the right and left hip-bones; 3, 4, the sockets for the heads of the thigh-bones; 5, 5, openings in the walls of the pelvis, which are naturally closed by strong membranes; 6, the union of the pubic bones (*symphysis pubis*).

The ovaries show no activity from birth through infancy, childhood and early girlhood; they are, as it were, sleeping; but when the girl assumes the womanly development of form and feature, the broadening hips, and expanding bust, these organs are in full activity; indeed, if they are absent or seriously diseased, the feminine characters of form, of expression, of voice and of action are generally wanting.

The life of the ovaries consists in the development and discharge, usually at regular periods, of ova, of which the two ovaries contain not less than six hundred thousand; nature, by this abundant supply, providing, as it were, against all possible contingencies, for the continuance of the race.

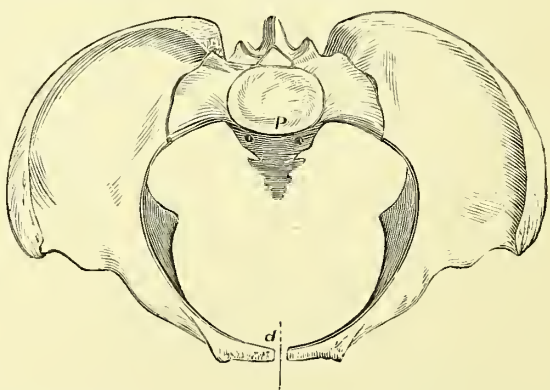


FIGURE 190.—The female pelvis, seen from above; *p*, the promontory of the sacrum; *d*, the pubis.

Ovulation is the term given for the perfect development, or ripening of an ovum and its escape from the ovary. The usual sign that ovulation is just about to take place, is a discharge of blood externally, which comes from the interior of the womb.

Because this discharge occurs once a month, the term menses (the Latin word for months) is applied to it, while the process is known as menstruation.

Various other expressions are used to indicate menstruation,

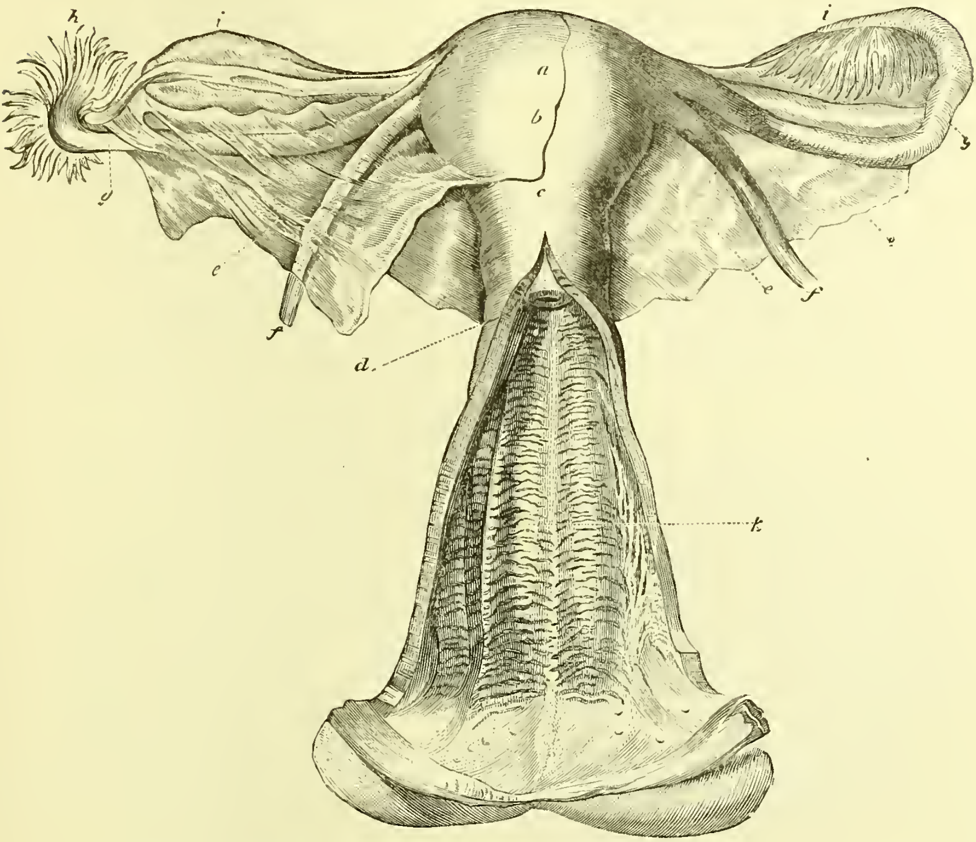


FIGURE 191.—The female organs of generation, seen from in front after removal from the adjoining parts. The vagina has been laid open by an incision through its front wall. *a*, the body of the uterus; *b*, the divided edge of the peritoneum which has been removed from the organs on the left side (right side of the page); *c*, the cervix, or neck of the uterus; *d*, the os or mouth of the uterus, projecting into the vagina; *e*, *e*, the broad ligaments which pass sidewise to the pelvis and support the uterus laterally; *f*, *f*, the round ligaments connecting the uterus with the pubis; *g*, *g*, the Fallopian tubes; *h*, the fimbriated or fringe-like extremity of the Fallopian tube of the right side; *i*, on the right side, the ovary; on the left side the fringed extremity of the Fallopian tube is closely applied to the surface of the ovary, as occurs when an ovum is discharged; *k*, the vagina.

such as being "unwell," "poorly times," being "regular," "periods," "courses," etc. The Chinese speak of a woman menstruating as having her moons, while in patriarchal times the same idea was conveyed by "custom of women."

The flowing of blood is usually the external sign of that vastly

more important process occurring in one or the other ovary, the ripening or maturing of an ovum, and therefore an indication of the capability for conception.

Although ovulation and menstruation are generally associated, yet they are not inseparable ; the one may occur, but probably in only a very few exceptional cases, without the other.

While menstruation marks the accession of female puberty, and is the general indication of the capability of conception, it does not follow that it is proper this function should be exercised, for there is a broad distinction to be drawn between the age at which conception is possible and the age at which it is proper. Both in the animal and vegetable world early production usually gives an inferior product, and tends to the early decay of the producer.

It cannot be too strongly enjoined upon parents that, as a rule, their daughters should not marry under twenty years of age.

Another excellent rule on this point is that, in an individual, growth must have proved its completion by having ceased for a year.

If boys do not attain that criterion of manhood which the right to vote indicates until twenty-one years of age, why, then, should girls whose physical, intellectual, and moral economy belongs to girlhood, be permitted to assume the grave responsibilities and severe trials of maternity—trials and responsibilities that properly belong only to perfect womanhood ?

Were the rules which we have mentioned observed, women would suffer less than they do, they would produce healthier offspring, and human happiness would be increased.

Returning to the history of the ovum, it is set free by the rupture of the enclosing sac, and is received by the Fallopian tube, which grasps, by its fringed extremity, the ovary during menstruation ; this latter relation insuring against the ovule dropping into the abdominal cavity.

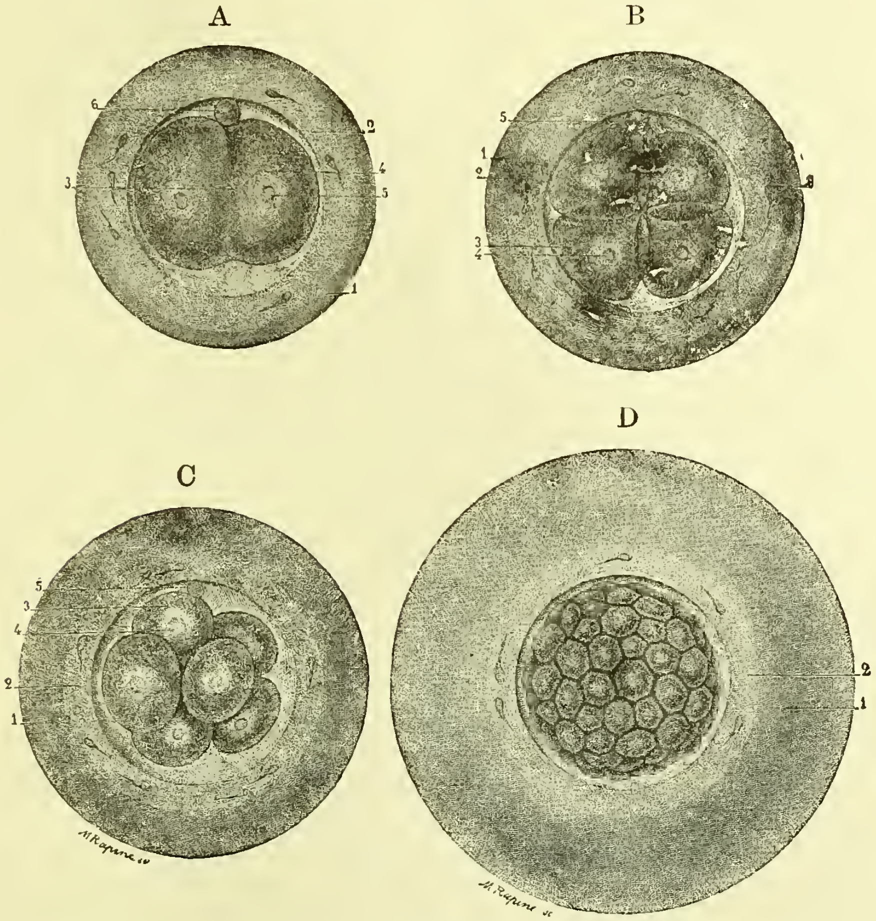
FIGURE 192.—Spermatozoa of the male, very greatly magnified.

In case of conception, the ovule most probably either before leaving the ovary, or quite early in its passage through the Fallopian tube to the uterus, meets the spermatic secretion, the fertilizing element contributed by the male. (See Fig. 192.)

The essential elements of this secretion consist of long, slender bodies measuring from $\frac{1}{600}$ to $\frac{1}{400}$ of an inch in length. These bodies move rapidly, and retain their vitality for some days if kept at the temperature of the human body.

The spermatozoa, as these little bodies are called, actually pene-

trate the ovum (see Fig. 193), and the greater the number that thus enter it, the more certain the conception ; once having entered, they lose their distinctive character, and the changes that are to convert that ovule into a human being are commenced.



FIGURES 193 TO 196.—The changes which the ovum undergoes shortly after impregnation: A, the vitellus, or yelk inclosed in the vitelline membrane (1), has separated into two portions at the point marked 3, each one having its nucleus (5); in the next figure (B) these masses have again divided, making four, and in C the number are again doubled, until in D they have become very numerous. Through the vitelline membrane may be seen the remains of the spermatozoa. These figures are all diagrammatic and very largely magnified.

When this combination of the male and female elements, or impregnation occurs, is not determined, but probably some hours, if not days, intervene between insemination and impregnation.

It is known that women are more liable to conceive either just before or just after menstruation ; but remembering, as previously

stated, that ovulation may happen without menstruation, or at any time in the menstrual interval, it will be seen that there is no period in which intercourse can be had with a non-pregnant woman and impregnation not be *possible.*

Nor is it essential for impregnation that there should be actual *penetration,* as it is termed, when the seminal fluid is discharged; even if that fluid is deposited upon the external sexual organs, such is the vitality of the spermatozoa and such their facility of motion, they may find their way to the interior of the womb, and thence into one of the Fallopian tubes, and from there to the ovary.

The impregnated ovule in its passage through the Fallopian tube becomes covered with an albuminous material, similar to the albumen which we see surrounding the yelk in the eggs of birds —in each case designed as nourishment for the new being.

In the yelk the most important change is the division into two equal parts (see Fig. 193) ; each of these halves likewise divides, and these divisions and subdivisions go on (see Figures B and C) until the entire yelk is converted into a granular mass, which from some fancied resemblance to a mulberry has been called the mulberry body (Fig. D).

The next step is the arrangement of these granules or cells so as to form by their union a membrane with an internal and external layer ; from this membrane the embryo or rudimentary child is formed, and also two of the three coverings which surround it like a sac or bag. Upon the arrival of the ovum in the womb it is, as it were, grafted on to a portion of its lining membrane (Fig. 197), generally at the upper part of this organ ; and just as the luxuriant grass soon grows so as to completely conceal a stone cast upon the ground, so the growth of the mucous membrane around, behind, and finally over this newly-lodged ovule takes place until the latter has a new and complete covering added to its own. (Figures 198 and 199.) This is the external of the three membranes which surround the embryo, for such is the name frequently used for the product of conception up to the period known as *quickening,* or more properly up to the completion of the third month, after which it is called a fœtus.

Those shag-like projections (shown in adjoining figures) have a temporary use ; like the fine rootlets of a tree they absorb nourishment. After this temporary use most of them shrivel away, while a few at the point of attachment of the ovum, by their increased growth, contribute to the formation of an essential organ for the life and the development of the fœtus. This organ is known, from its supposed resemblance in shape to a cake, as the *placenta,* and

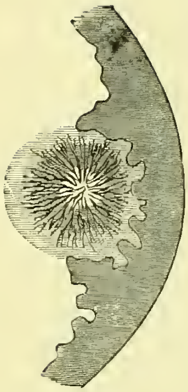


Fig. 197.

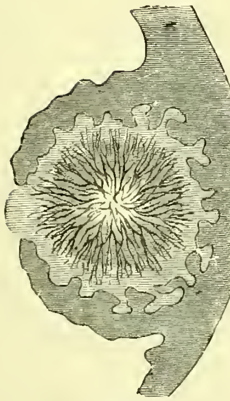


Fig. 198.

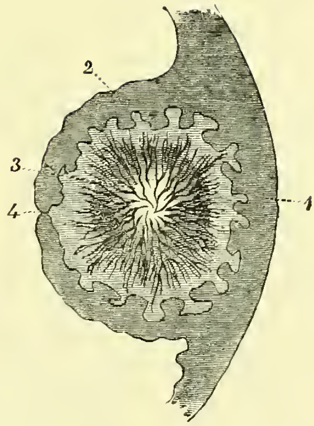


Fig. 199.

Figures 197 to 199.—The formation of the *decidua*, or the membrane which surrounds the fœtus: 1, the wall of the uterus; 2, the commencement of the decidua; 3, the ovum covered with its shaggy coat (the corium) and imbedded in a quantity of mucus; 4, the point where the mucous membrane forming the decidua comes together over the ovum and forms a closed sac.

Figure 200.—The after-birth, or *placenta*, as seen from the side which is attached to the inner surface of the uterus. Its surface is divided by deep fissures into lobes or cotyledons, the blood-vessels of which have no direct connection with each other. Around the margin is shown a part of the membrane which forms the shut sac containing the fœtus and the amniotic fluid.

from its being delivered subsequently to the birth of the child, as the *after-birth.*

The placenta is a soft, spongy mass which, when fully developed, weighs one pound, is an inch in thickness, and six inches in diameter. At the end of the third month it is, though then com-

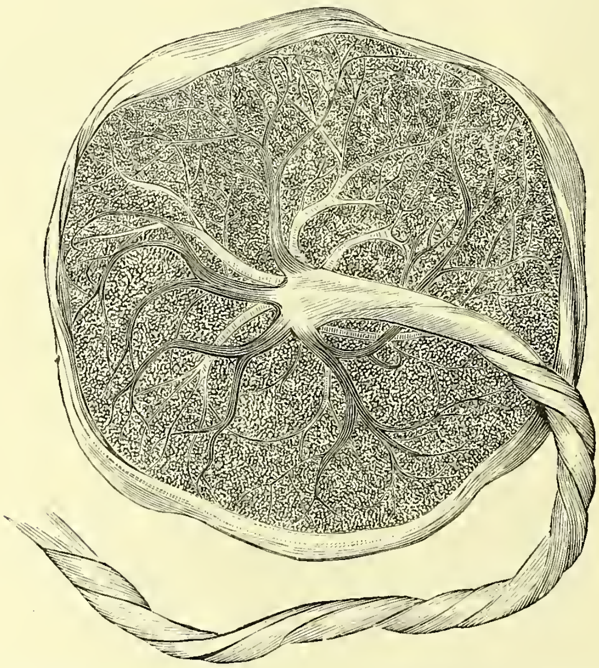


FIGURE 201.—The after-birth, or *placenta*, as seen from the side which is next to the fœtus, and showing the arrangement of the blood-vessels which unite to form the navel-cord. (About one-third the natural diameter.)

paratively small, distinctly formed. The placenta is placed in relation with the embryo or fœtus by means of the *umbilical cord.*

The cord averages twenty inches in length, is about the thickness of the little finger, and consists essentially of two arteries which convey blood from the fœtus to the placenta, where it undergoes certain changes by being brought in relation with the mother's blood (only a thin membrane intervening), by which changes it is purified and rendered again fit for the nourishment of the fœtus, and of a vein which returns this revivified blood. The arteries and veins are surrounded by a jelly-like fluid enclosed in a fine network of fibres, and all covered by a membrane. Usually, the cord is twisted in shape; sometimes it is not uniform in thickness, having irregular projections at different points, and occasionally

one or more actual knots may be found in it; knots that have been formed by the fœtus in its movements.

Not merely is the fœtus enclosed in a membranous sac, but also a watery fluid, known as the liquor of the amnion, amounting at the end of pregnancy to one or two pounds. The chief uses of this fluid are the protection of the fœtus from blows or falls, and the cord from such pressure as would hinder the circulation of blood in it; facility of motion for the fœtus, and facility of dilatation of the mouth of the womb, by the gentle and equal pressure of this water-bag, which is pushed down in a plug-like form by the power of uterine contractions, at the time of labor.

To the embryo and its coverings, or fœtus with membranes and placenta, the term ovum is applied. At the end of the first month the ovum is the size of a pigeon's egg, and the embryo, one-third of an inch in length; at the end of the second month the former

is the size of a hen's egg, the latter one and a half inches long; at three months the length of the embryo is two and a half inches, and the size of the ovum equal to that of a goose's egg.*

At four months the child weighs four to six ounces, and is six inches in length; the sex can be distinguished. At five months its weight is ten ounces, its length is nine or ten inches, and the commencing formation of the nails is observed. The infant at six months weighs about one pound, and is eleven to twelve and a half inches long. At seven months the weight is three to four pounds, and the length thirteen to fifteen inches; and at eight months the former is four to five pounds, and the latter sixteen to eighteen inches. At birth the child will be found to measure nineteen to twenty-four inches, and to weigh about seven pounds.

Male children are slightly larger than females. Twelve pounds is a *very* extraordinary weight for a new-born child, and there is no authentic case of one weighing twenty pounds.

Of course with such rapid and remarkable development of the ovum, there must be a corresponding development of the uterus which contains it. This organ is estimated to increase to twenty-four times its original weight, and to have a capacity five hundred times greater than before pregnancy.

* Of course the measurements here given should be regarded as representing averages, and the size suggested merely furnishing approximate comparisons.

Pregnancy is spoken of as single or multiple, according as the uterus contains one fœtus or more.

Twins are found once in 89 births ; triplets once in 7,910 ; four at a birth once in 371,126 cases, while five are still more rare, and there is no authenticated example of a larger number.

Another division of pregnancy is into *intrauterine* (the usual form) and *extrauterine ;* but the latter is at once so rare and so grave an occurrence that it may be left solely to the consideration of the profession.

Signs of Pregnancy.

Pregnancy is also sometimes referred to as *true* and *false* (though of course, strictly speaking, there is no such condition as false pregnancy), and this naturally brings us to an examination of the symptoms or signs of pregnancy. Most of these signs will be what are termed *probable*, but the combination of probabilities may make a certainty. Nevertheless, in all doubtful cases, and especially those where great interests are involved, reputation, the peace and happiness of families, life itself, possibly, at stake, it should be remembered that there are *certain* signs, and that these are early appreciable only by the skilled eye, ear, and touch.

Cases of imagined pregnancy now and then occur; one of the most remarkable of which was that of the notorious Joanna Southcott, who when upwards of sixty years, believed, her abdomen really being enlarged by dropsy, that she was the subject of miraculous conception, and was about to give birth to a new Shiloh. Cases of concealed pregnancy are more frequent, and sometimes an unfortunate girl who has lapsed from virtue, loving not wisely but too well, will not permit even the agonies of childbirth to extort an acknowledgment from her lips, or will die from some of the diseases of pregnancy, keeping her secret to the last, and in her strong love concealing the author of her ruin.

Still sadder, if possible, are cases of unjustly suspected pregnancy, as, for example, when the menstrual secretion for several months is prevented from escaping externally by some obstruction, and the abdomen enlarging from the periodical accumulations, the poor girl is accused of a pregnancy, which from this very obstruction is an impossibility; or again, abdominal enlargement, from tumors either of the womb or of the ovary, has also frequently been the occasion of unjust charges of pregnancy, causing innocent hearts unutterable grief, and clouding reputation, if not destroying life.

There is a popular notion that a peculiarly pleasurable sensa-

tion frequently attends fruitful intercourse, so that a woman may then know at once she has become pregnant, and a few obstetric authorities endorse this opinion.

We have already learned that some hours, if not days, intervene between insemination and impregnation, and we know that various contingencies may occur, interfering either with ovulation or with the actual union of ovule and spermatozoa, and therefore it is probable that this opinion should be set down as the dream of vivid imaginations rather than the expression of scientific truth. Fruitful intercourse may occur when woman is suffering pain, sorrow, fear, or when under any other depressing agency ; it may occur when she is utterly unconscious, buried in profound natural sleep, or in that induced by chloroform, opium, etc—in so far powerless and passionless in the creation of a new being.

Among the earliest symptoms of pregnancy is the absence of menstruation. If the subject be in good health and has hitherto been "regular," and if there has been neither mental nor physical shock to explain this failure of the flow, there is a probability that conception has occurred, and this probability of course greatly increases each successive month the flow is absent.

But a woman may conceive without ever having been unwell—this is quite an exceptional case ; or while nursing, and this is not uncommon. Again, some women during the earlier, or even all the months of pregnancy, may have a periodical hemorrhage. It is doubtful whether this should be considered menstruation, but rather a threatening of miscarriage, or of premature labor.

Finally, conception may take place after a woman has passed, as she supposes, the critical period of life, and the flow been absent for many months ; but this too is altogether an exceptional case. It should be borne in mind that a woman may wish to conceal the fact of being pregnant. She may assert that menstruation is not arrested, or, acknowledging its absence, attribute the arrest to "taking cold."

Nausea and vomiting are symptoms that usually appear in the second month, although they may commence in the very first week of pregnancy, and generally last six or eight weeks. From the fact that this sickness is most marked soon after rising, it is commonly known as morning sickness. Some do not experience this disorder at all ; with some others it may be but a slight indisposition; and in a very few cases it is a constant suffering by night and by day, preventing nutrition and rest, and may terminate either in abortion or in death. This sickness, which should not be confounded with that sometimes occurring in the latter part of

pregnancy and explained by the pressure of the enlarged uterus upon the stomach, is generally regarded as sympathetic.

At about four months and a half, sometimes earlier, sometimes later, the mother becomes conscious of the motions of the fœtus. These motions as first felt are quite feeble, and have been poetically compared to the flutter of a bird ; they frequently occasion some feeling of faintness. To these the term quickening is applied, although it perpetuates an error, since in former times the new being was then regarded as becoming *quick* with life, while the truth is, that it was living from the moment of union of sperm-cell and germ-cell, and movements too were made some time before those that are first felt.

These movements, at first so faint that the mother feels them like the throb of a feeble pulse, by and by become perceptible to the hand placed on the abdomen ; when they are not promptly

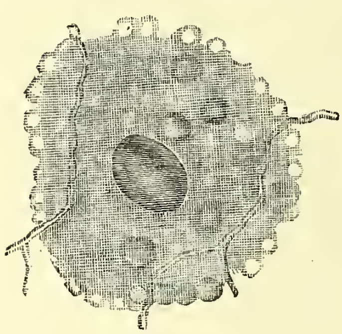


Fig 202.

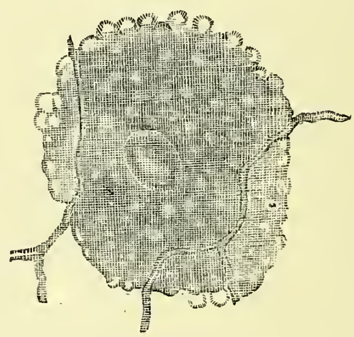


Fig. 203.

Figures 202 and 203.—Showing the appearance of the nipple commonly seen in pregnancy. Two veins are represented as showing through the skin. At the margins of the areola or dark surface surrounding the nipple is shown the "secondary areola," in which the coloring matter of the skin (*pigment*) is less than in adjoining portions, forming light-colored spots similar to those made by drops of water on an India-ink or sepia drawing.

recognized, a cold hand, a little firm pressure, or a smart tap with the fingers will generally excite them, or, better still, after patiently waiting they will occur spontaneously. When these movements are once plainly recognized, the fact of pregnancy is of course certain. But it ought to be added that sometimes fœtal movements are imagined, and in other cases simulated, so that then a thorough medical examination is necessary to dispel the delusion or to discover the fraud.

Important changes occur in the breasts consequent upon pregnancy. About two months after conception they become larger, firmer, and are the seat of occasional tingling, stinging pains.

The nipples are larger and more prominent; often, as pregnancy advances, a little milk-like fluid can be pressed out of them, or escapes of itself. But the most remarkable changes occur in the areolæ or circles around the nipple. The inner one of these becomes much darker, and the little pimple-like elevations scattered over it, which are really miniature mammary glands, become enlarged and more prominent. The changes in the outer, or secondary areola, are not so marked, the color not being near so deep; the surface is like a somewhat dusty, dingy white paper, upon which drops of water have fallen. It ought to be observed that this sign of pregnancy is much more marked if the pregnancy be the first, and if the subject be a brunette. In women of very fair skin and of blond hair the sign is not well marked, nor is it always in others who have passed through one or more pregnancies.

Pigmentation, as it is termed, so plain in the inner areolæ of the nipples, is one of the most remarkable results of the pregnant condition. It is not limited to a part of the breasts, but frequently is observed upon the middle line of the abdomen, extending as high as the navel; or, again encircling the navel and then passing up to a point opposite the lower portion of the cartilage of the breast-bone. So, too, similar discolorations not unseldom are observed upon the forehead and the cheeks, or hands, and exceptionally upon the chest of pregnant women.

Changes in the form of the abdomen are not marked in the first month. Occasionally there may be some gaseous distention of its lower part, commonly spoken of as bloating, but this is not permanent.

In the second month the uterus sinks lower from its increased weight, and there is some flattening in the lower middle part of the abdomen, as well as a sinking in or retraction of the navel.

By four months the enlarged uterus can be felt as a distinct globular tumor where the flattening was observed in the second month.

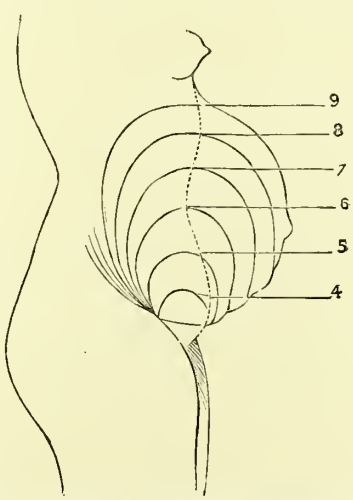


FIGURE 204.—Diagram showing the comparative size of the uterus at different months of pregnancy.

This change, as well as the subsequent ones and those that occur in the navel, are indicated in the adjoining illustration.

The uterus, as it rises higher in the abdominal cavity, generally inclines to the right side. In women who have borne many children, the ascensional movement is not so well marked, for, from the relaxation of the abdominal muscles, the womb as it enlarges is apt to fall forward, and its superior part or fundus scarcely passes the navel even near the end of pregnancy.

The sounds of the fœtal heart may be recognized by an experienced ear at four months, sometimes at three and a half, very rarely earlier, and furnish a conclusive evidence of pregnancy, so that in all cases when absolute certainty is required at this period of supposed pregnancy, an examination by a physician should be made.

HYGIENE OF PREGNANCY.

What mode of life should be adopted by the pregnant woman in order that the nine months of gestation may be completed, and her labor accomplished with as little suffering as possible, giving birth at their expiration to healthy offspring, and be best prepared for the trials and tasks of maternity, is a question of no little moment.

Dress.—First, her clothing should be adapted to the season, and to her successive changes of form. All compression of abdomen and chest should be carefully avoided, and even the pressure of heavy garments suspended from the waist is often injurious. "The Romans were so well aware of the mischief caused by compression of the waist during gestation, that they enacted a positive law against it; and Lycurgus, with the same view, is said to have ordained a law compelling pregnant women to wear very wide and loose clothing."

Breasts.—The breasts, and especially the nipples, ought to be free from all external restraint to their development. The former, if painful, may occasionally be gently bathed with a liniment composed of equal parts of sweet oil, laudanum, and spirits of camphor. If the nipples are sunken, retracted, an ivory or glass nipple-shield should be worn over them, and besides they may occasionally be drawn out by a breast-pump.

In the last six or eight weeks of pregnancy it is advisable, if the skin of the nipple is at all tender, to harden by applying twice a day a saturated solution of alum or borax in whiskey, or a wash of sulphate of zinc, in the proportion of three or four grains to an ounce of water.

Binder.—After the sixth or seventh month a suitable abdominal bandage will contribute to the patient's comfort and facilitate her

movements, if these are hindered by too great inclination of the uterus forward.

Food.—A woman should live very much as she has been accustomed, but should avoid alcoholic stimulants and highly seasoned dishes; simple, nutritious food should be taken in such quantity as her appetite demands.

As to any desire for particular articles of food and unusual caprices of appetite, in so far as it is possible and when the food is digestible, let her wishes be gratified. But when the desire is for that which is not food, that which is not fit for the human stomach, let it be firmly denied. In nine cases out of ten it is a simulated wish, or imagined want—as pure an affectation as was the insanity of Ulysses when he was plowing sand and sowing salt. So, too, the popular notion that unless these desires, these *longings* as they are termed, are gratified, the infant will be marked, have some deformity, has no foundation in reason, and the stories of such results are fables rather than histories.

The daily evacuation of the bowels can in most cases be secured by a proper diet, a diet which in part should consist of fruits, bread made of unbolted flour, cracked wheat, oatmeal, etc.

Exercise.—During the first two or three months the pregnant woman is little disposed to physical exertion, chiefly from the nausea and vomiting generally incident to this period, as well as from the consequent weakness. So, too, at the close of pregnancy, the difficulty in moving is so great that she naturally inclines to be quiet. To a certain extent these feelings should be respected.

The general rule in regard to exercise in pregnancy is that it should be frequent, but not violent. Dancing, horse-back riding, or riding over rough roads, should be avoided. Fresh air and sunshine should be had, if possible, each day; a reasonable devotion to domestic duties should occupy the mind, and contribute to the hopeful, cheerful disposition, and there should be an avoidance of crowds, public excitements, and late hours. At three months and at seven—the one presenting a greater liability to miscarriage, the other to premature labor—less exercise should be taken than usual, and any threatening of either of the foregoing accidents should be the signal for absolute rest.

Intercourse.—There is a topic which may be referred to in this connection, and upon which a few plain words may be said, even though possibly it will be, as suggested by another, *the voice of one crying in the wilderness*, viz., sexual intercourse in pregnancy. Among the animals such intercourse ceases with pregnancy.

When the purpose for which an instinct exists has been accomplished, ought not a wise reason and a resolute will to hold it in

check? And will not the exercise of such reason and will, the restraint of an imperious and blind propensity purify the heart, ennoble and strengthen the character? Much suffering of woman in pregnancy, many an abortion and premature labor would be thus prevented.

If any obstetric authorities give either positive or implied consent to the indulgence of intercourse in pregnancy, it is like the old story of Moses' concession to the hardness of human hearts.

Bathing.—In pregnancy the same attention to personal cleanliness by the usual bath, should be observed as in the non-pregnant condition; the cold baths if used before may be still continued, but it should be remembered that a prolonged stay in a warm bath is too relaxing, and therefore injurious.

Rest.—Regularity in the habits of life should be observed as much as possible, and sufficient sleep secured. Nevertheless, if this sleep cannot be obtained at night, the loss should be compensated for by a few hours' rest in the day-time.

Mental Habits.—The mental condition incident to pregnancy is often characterized by despondency, sometimes amounting to a profound melancholy. So too, there is frequently great irritability of temper, or extreme sensitiveness, and any harshness or unkindness, however unintentional, is keenly felt, and may excite hasty words or copious tears. But a woman should remember that "a calm and equable temper, a life of quiet cheerfulness and active duty," are most conducive not only to "her own health, but to that of her offspring also;" and that while pregnancy is often a very heavy cross, maternity is the crown of womanhood.

If in old times among the Greeks, strangers even testified, by respectful salutation to the pregnant woman as she passed on the street, their regard, how much more should those immediately around her, those of her own family and kindred treat her in all things courteously, kindly, and considerately?

THE TERMINATION OF PREGNANCY.

The duration of pregnancy has already been referred to, and its usual time has been spoken of as two hundred and seventy-eight days. But may this period be prolonged? The French law declares the legitimacy of an infant born within three hundred days after husband and wife have ceased to live together; and in Germany a still more liberal period is granted, viz.: from the three hundred and first to the three hundred and eighth day.

Neither in Great Britain nor in the United States has law established a definite period. By the common law a woman was

not permitted to marry until a year after a husband's death, and this would seem to imply that she might give birth to a child by the former husband within that time. In this country cases of disputed legitimacy from alleged prolonged pregnancy are decided according to the facts and the testimony of medical experts.

Labor is the process by which pregnancy is naturally terminated. It is travail, a toiling; it is parturition, a bringing forth, giving birth, delivery. In order that we may appreciate its most important phenomena, let us consider for a moment the object upon which the forces of labor are exerted, what those forces are, and the space, the canal which that object must pass through in order to be expelled, to be delivered. Of course the object is the mature fœtus, and in regard to it, in studying labor, these terms must be defined, to wit, *attitude, presentation, position.*

FIGURE 205.—Position assumed by the child in the uterus, when fully developed.

By attitude is meant the posture of the fœtus in the womb—the disposition of its body and limbs.

Upon looking at the subjoined illustration it will be observed that the head is somewhat bent upon the chest, the back curved, the arms folded, the lower extremities drawn up, the thighs on the body and the legs crossed, so that an ovoid, an egg-shaped form is made: this is the *attitude.*

Presentation is that part of the fœtus which is caused to descend first in the process of expulsion—that part, therefore, with which a finger introduced into the vagina first comes in contact, or finds lowest—that part which in the process of parturition is in the axis of the canal.

There are simply three *types* of presentation, one or the other extremity of the ovoid, as shown in the above drawing, may descend first, or the fœtus may be transverse—lying crosswise, and thus we have presentation of the head, of the breech (the former occurring twenty times to one of the latter) or of the body: the two first constitute natural presentations.

The statement that presentation of the head is natural requires qualification. It is natural in the vast majority of cases, and is

the most favorable for mother and child. But there may be deviations from the ordinary position in which it presents—some other part than what obstetricians know as the vertex may descend first, and the deviation be fraught with peril to both mother and child.

By *position* is meant the relation which the presenting part bears to the upper part or superior strait, as it is called, of the mother's pelvis, this pelvis being the bony portion of the canal through which the fœtus must pass.

The forces concerned in parturition are, first, the uterine contractions, and second, these aided by the voluntary contractions of the abdominal muscles.

Let us now trace the natural history of labor. And first, of those symptoms which indicate the approach of this termination of pregnancy.

Commencement.—In some cases labor sets in abruptly, often in the night during the calmest sleep. But this sudden accession is exceptional, especially in the case of women who have borne children.

Change in the form of the abdomen, variously termed subsidence of the abdomen, settling down of the womb, etc., is one of the earliest indications of approaching labor. This change generally occurs unconsciously and somewhat suddenly: for example, the patient finds upon rising in the morning, that her waist is very much smaller, and that the uterus is lower and projects in front more than it did the evening before ; the presenting part still covered by the womb, has partially descended into the pelvic cavity. This last fact is favorable, for it indicates a sufficiently large pelvis. Unfortunately, the uncertain time — it may be one or two days, or two or three weeks, before labor commences — at which this change occurs, renders it a sign of no great value in determining the date of probable parturition.

Derangement of the Bladder and Bowel.—Consequent upon the change referred to there will be increased irritability of the bladder ; possibly some disturbance of the rectum, and certainly greater difficulty in standing and in walking.

Leucorrhœa.—Swelling of the external organs of generation with increase of mucous secretion, and, in addition, a thick, glairy discharge like the white of an egg, proceeding from the glandular structures of the neck of the womb, will be observed. The abundance of these discharges, especially of the latter, is a favorable indication as to the character of the labor.

Mind.—There is a change in the patient's mental condition as she realizes the approach of parturition. She naturally seeks

retirement, if not repose ; her mind is filled with "hopes and fears, an undistinguishable throng." She generally rises to the emergency just awaiting her, and the gloom and despondency that may have marked the weary months of pregnancy are lessened or altogether disappear as she sees the end at hand.

Uterine Contractions.—Painless contractions of the uterus are, like the leucorrhœa referred to above, among the near indications of approaching labor. A woman is conscious at distinct and frequent intervals of the womb becoming harder and more prominent.

The actual existence of labor is characterized by regularly occurring pains. These pains commence in the back, the sacrum, and extend in front. They attain to a certain intensity, and then die away. They are successive waves of suffering, separated by definite intervals of rest. During the occurrence of a pain the uterus seems to rise up, and becomes harder and more prominent.

The characters just mentioned enable one to distinguish between these true labor-pains and false labor-pains, the latter being irregular as to intervals and duration and occurring in one or another part of the abdomen. These false pains may arise from colic, from constipation, or from irritating matter in the bowels ; in the first case requiring simply an opiate, in the others a laxative such as castor-oil.

Pain is used, in obstetric language, as synonymous with contraction, but really the former is the consequence of the latter, and, although the two are generally associated, in some rare cases labor may commence and be completed without pain ; delivery take place without suffering. The rule, however, is otherwise, and not only are pains and contractions associated, but the intensity of the one is generally the measure of the intensity of the other.

In order to facilitate the description and also because of the difference of the phenomena, labor is divided into three stages.

The *first stage* of labor includes the complete opening or dilatation of the mouth of the womb, so that the presenting part of the child—the head for example—can escape from the uterus. The pains which occur in this stage are spoken of as cutting, grinding, preparatory or dilating pains. During it the patient is often irritable, restless, changes her position frequently, thinks her suffering is accomplishing nothing ; her body writhes and she moans or cries out with each successive pain, sometimes declaring that her back is breaking, that she knows she will die, etc. The intervals separating the pains become shorter as this stage advances to its conclusion ; at first they may have been twenty or thirty minutes in length, now they are six or eight, or even less.

The dilatation of the mouth of the womb is accomplished solely by the successive contractions of the womb; voluntary effort has no part in it whatever, and no such effort should be made.

The *second stage* of labor includes the expulsion of the child.

With the advent of this stage important changes take place in the disposition and conduct of the patient. The contractions of the uterus are now materially supplemented by the fixing of the diaphragm, and the contraction of the abdominal muscles, a straining, a bearing-down effort being made.

The patient no longer twists and turns her body, and moans or utters impatient or reproachful exclamations with the pain, but fixes her body, grasps some object firmly with her hands, holds her breath; her face is flushed, bathed with perspiration, and the cry of anguish comes, if at all, as a burst, an explosive utterance when she can hold her breath no longer, and the pain is over. She now feels that she is an actor and not merely a sufferer, and all the heroic element of her nature is roused up to do and to endure. The presenting part, being in a favorable position, descends lower—the bag of water is generally ruptured soon after the commencement of this stage of labor—the head presses upon the soft parts—the pains come nearer together, only two or three minutes separating them—the external opening of the vagina gradually enlarges—until finally, with one supreme effort, the head is born. The body soon follows; and the second stage of labor is accomplished.

The *third stage* is the delivery of the placenta, or after-birth. This usually takes place without much suffering, and within five to twenty minutes after the delivery of the child; sometimes the after-birth follows the child immediately.

The duration of labor varies somewhat (according to whether it is a first confinement or not) as to age, constitution, health, mental condition, disease, conformation, etc. The average for a first labor is about twice that of subsequent labors, or twelve hours, though it may be prolonged to twenty-four. The first stage of labor is generally about two-thirds of the entire time; thus, a woman who has borne children, and whose labor occupies six hours, will have four of the six spent in the first stage.

Management of Labor.

One of the prominent thoughts in the mind of a pregnant woman, when the time of her confinement is at hand (if not much sooner), is as to professional attendance.

While in the vast majority of women labor is purely a physio-

logical process, presenting no emergency demanding any great knowledge or skill, and an intelligent nurse might be equal to all the duties required by the patient, yet who can foresee that in an individual case the event shall be so fortunate? The accidents, the perils of parturition, are among the gravest that occur to human beings. To foresee and to prevent, if possible, these perils, or to successfully meet them, demands education, skill, firm resolution, prompt action. The great emergencies of obstetric practice often come suddenly; and when the signal for action is flying there is no time for councils, for deliberation. Delay may be defeat and death. Not only so, but such practice differs from other departments of medicine in this: that not merely one, but two lives are involved.

Can anything more be said to enforce the declaration made by a famous French obstetrician of the seventeenth century, that no branch of medicine is inferior in dignity and importance to this? Need anything more be said to impress the necessity for education and skill on the part of the obstetric practitioner?

It is advisable that the physician should be engaged considerably in advance of the confinement, so that, visiting the patient from time to time, if there are any important derangements of health they may be discovered and corrected. It is by such attention that safe parturition may be secured rather than by using any special medicines for such purpose. Indeed, the notion that there are specific medicines of this sort—medicines that, given during pregnancy, will cause the labor to be safe and easy, is at once an evidence of human cupidity and of human credulity; and whoever prescribes these medicines, alleging that such results will follow, should be set down as too ignorant or too unscrupulous to be worthy of any confidence.

The professional attendant should be advised at the first accession of labor pains; the nurse, probably, is already in attendance, or, if not, should at once be sent for. The lying-in room should be airy and quiet, removed as far as possible from the noise of the street, or of the household—and it is not necessary that it should be flooded with light, either natural or artificial; on the contrary, a twilight better corresponds with the patient's feelings and desires. Her wishes should be consulted as to the persons to be present in her hour of trial. It should be borne in mind that there is more danger of having too many than too few; that the presence of one to whom she has an aversion is a great detriment, or positive hindrance to labor; that one female friend or relative, in addition to the nurse, will generally be quite sufficient; and that the conversation of those who *are* present should be cheerful and

calculated to inspire hope and faith. It can scarcely be possible to do greater harm by anything than by the recital of tedious labors and all the dreadful accidents of childbirth they may have witnessed or heard of.

The greatest sin of some nurses is, after that of liberal dosing sick women and babies with all sorts of extemporaneous medicines, *loquacity:* they *talk,* talk tattle or scandal; their own triumphs, and others' failures; this doctor's knowledge, or that one's ignorance; make known the private affairs of the families in which they have been; talk of something, or talk of nothing, but talk continually, unless asleep, until the sick, unwilling listener could have nothing more refreshing than half an hour's silence!

Positive promises of a speedy termination of labor, or at any definite time, should not be made either by the obstetrician or by others; so many contingencies may occur to cause delay in parturition, and so much mischief may result from disappointment, that only probabilities rather than certainties should be the answers to the requests of the sufferer, unless the last steps of the second stage are at hand.

So, too, any word or act calculated to underrate the severity of the suffering of childbirth, to treat it as comparatively trivial, can only come from an ignorant, or a rude and unsympathetic nature.

By a wise provision of nature, the suffering attendant upon labor is divided, broken up into parts, so that the burden, which otherwise would be crushing, can be borne; the intervals of rest between the pains enable the woman to recruit her forces, and thus to meet each new pain with resolution and patience.

During the first stage of labor it is better for the patient not to be in bed; she will grow weary enough of lying down after a while, and at any rate sitting is more favorable for the entrance of the presenting part of the child into the pelvic cavity.

So, too, she should turn a deaf ear to the importunities of injudicious friends who may urge her "to bear down," "to help herself," for all such efforts in the first stage of labor are a vain and injudicious waste of strength.

During labor the patient is little disposed to eat, even if she be not suffering from nausea, a not uncommon occurrence.

Her thirst will be satisfied by frequent drinks of cold water, and they will be better for her than any alcoholic mixtures or hot teas that officious friends may unwisely advise her to take.

If her bowels are at all costive, some mild and prompt aperient like senna, or an injection, should be administered.

With the commencement of the second stage the patient should lie down in bed ; a mattrass should be used, and not a feather-bed ; and upon this should be placed, at the part where the patient's hips are to rest, a piece of rubber cloth, two yards by one yard and a half in size, and extending over the edges of the bed. Upon this should be placed a blanket, or "comfort," folded squarely four times, and again over this, in turn, a sheet similarly prepared. The object of these, of course, is to protect the mattrass from being soiled and wet. Bags of bran are sometimes used for absorbing the discharges. The under sheet of the bed should be folded so as not to reach as low as the hips, that it may be kept dry and clean until the labor is over.

The chemise and night-dress should be drawn up, for a similar reason, and a loose skirt, or a sheet properly folded, should be put round her hips.

The position in bed may be upon the left side or upon the back. if there be decided inclination of the uterus to the right side, as previously referred to, the former is the better position.

So, too, this is the better position in the delivery of the head if rupture of the perinæum is feared, as statistics show that such ruptures are more frequent when the patient is lying on the back. Any rings upon the fingers should be removed until the labor is over.

During a pain firm pressure with the hand upon the part of the back to which suffering is referred, is often a great relief ; at the same time the patient should bend forward the chin toward the breast, grasping the hands of either the nurse or of a female friend, while a resisting pressure is made by the other with the hands against the knee ; the persons who assist in this way during a pain—that is, by pressure upon her knees, and by holding her hands, or, better, her wrists—should simply balance the force she exerts, only furnishing for her fixed points against which she may pull and press.

The question of the use of an anæsthetic belongs to the second stage of labor more than to the first, and not at all to the third. While this matter must be left to the decision of the medical attendant, it may be said that the cases are altogether exceptional in which the judicious use of chloroform or ether by inhalation, or the administration of chloral in proper doses, in parturition, is injurious.

The brief sleep which may be had in the intervals of pain should not be interfered with. Bathing the hands and sponging the face with cold water will often be very grateful, and the patient should be allowed cold water to drink as she desires it.

As the second stage advances to a close, hot water should be in readiness, scissors and cord at hand (the cord may be made of strands of linen thread twisted and waxed), a warmed flannel skirt or shawl for wrapping the baby in, and spirits of camphor. The patient should restrain any violent efforts just as the head of the child is about to be born, for fear of tearing the perinæum.

The head born, the hand of the nurse or of an intelligent assistant should be placed over the womb—not flat, but the fingers and thumb curved towards the palm, so as to form with it a concavity fitting upon the rounded surface of the womb. At this time it is very much better for the patient to be on her back. Let moderate pressure be made, following the womb down as it descends and diminishes with the expulsion of the child ; and there that hand should be kept until the medical attendant is ready to replace it by his own. Such pressure secures firm and equal contraction of the womb, often in some degree prevents after-pains as well as risk of too great loss of blood—and, more certainly still, renders the delivery of the after-birth prompt.

The physician reinforces or assists the last contractions of the womb by a grasping pressure of this organ with his hand ; and the placenta is thus expressed or squeezed out just as a ripe cherry may be pressed between the thumb and finger until pulp and seed escape from the skin. The placenta, now lying loose in the vagina, may be drawn by the cord or removed with the hand; but any decided traction upon the cord while the placenta is still imprisoned in the womb, and possibly still attached to it, is unwise, and may be exceedingly dangerous to the life of the mother. A moderately firm grasping pressure should still be kept upon the womb; nor is it well to remove the hand until the bandage is being pinned.

The bandage may be made of a double thickness of coarse unbleached muslin, or of drilling, and cut and sewed to correspond with the shape of the abdomen ; or a coarse linen towel may be used. It should always be applied, as it contributes greatly to the patient's comfort, if not safety. In its application the patient should lie passive, especially avoiding any change from a perfectly horizontal position ; it should be drawn as tight as is comfortable for her, and the pinning should be done from above below, and not the reverse. There is rarely a necessity for compresses being placed in under the bandage ; and when there is, as when there is a relaxed condition of the womb and consequent risk of hemorrhage, it is better to use three towels, each rolled tolerably firmly, so as to make three cylinders, one of which is placed transversely upon the abdomen, just above the upper margin of the womb, and the

others on either side of the womb. Thus we have this organ boxed, as it were. The fourth side of the box is furnished by the pelvis, and the cover is the bandage firmly applied over the compresses.

Of course all the soiled clothes should be removed, and a dry, warm sheet, folded four square, be placed under the patient and napkins applied to absorb the discharge. The lower sheet of the bed and her chemise and night-dress may then be drawn down. An additional cover should be thrown over her, and the room, if it be cool weather, be made comfortably warm, as she is liable to become chilly from having perspired so freely in labor. More frequently a purely nervous shivering, without chilly sensations, occurs ; but this soon ceases.

Her head should be low—a simple pillow or the bolster being sufficient ; and even these may be for a time withdrawn, if she appears very pale or weak.

After having her bed and clothing made comfortable, the three wants of the newly-delivered woman are : a drink, rest, and food ; and they occur in the order mentioned. As to drink, this should be cold water, if she desires it ; generally it is the most agreeable, and rarely is it necessary or even advisable to administer an alcoholic stimulant.

A sleep of one, two, or three hours will be most refreshing, and it is an error to interfere with such rest from the notion that faintness or hemorrhage may result ; with a pulse under a hundred and a well-contracted womb, all fear of such accidents may be cast to the winds. Awaking from this sleep, her desire for food should be met—the kind of food largely dependent upon her previous habits and her present wishes ; it may be some animal broth, milk-toast, a soft-boiled egg, or simply tea and toast. At any rate, it should be borne in mind that she is not a criminal because she has had a baby, and is not to be punished by a bread-and-water diet ; that she has gone through hard toil, severe labor, and needs nutritious food to repair her exhausted forces ; and that the formation of good milk, for the nourishment of her infant, is also an indication for such food ; while starvation is quite as favorable to disease as over-feeding ; and that there is a happy mean which should govern the diet of puerperal women.

Management of the Child.

Immediately upon the birth of the head the attendant should examine with a finger to ascertain if the cord is around the neck ; and if it be, at once to disengage it by drawing the loop or loops down over the head, or slipping it or them over the shoulders.

Ordinarily the body follows very soon the delivery of the head; but should there be much delay, pressure upon the womb and gentle traction by a finger in one or other arm-pits of the child will be sufficient to deliver it.

The child is then brought near the edge of the bed, the covers removed from over it; when, ordinarily, it cries vigorously, showing that its lungs are fully inflated, and that it is prepared to live separated from the placenta. Should it not breathe, or only give feeble gasps, an abrupt change of position, pouring a little spirits of camphor or cold water on the chest, and friction with the hand, will probably startle it into a deep inspiration.

When once the child breathes freely, the cord should be divided, first tying it with the twisted and waxed thread, or with silk, in two places, the first about two, the second three inches from the navel; then cutting it in this interval with blunt-pointed scissors. It will be noticed that a sort of button is formed, which prevents the ligature next the child (the only one really essential) from slipping. Wipe the blood from this cut surface, and watch for any fresh discharge; if there be none, it is known that the ligature is tight enough; but if any blood oozes out, put on another ligature, and tie it more firmly.

Should the child not breathe, or give only faint gasps, if pulsations are felt in the umbilical cord, it is better to wait two or three minutes, and endeavor to reanimate the child by the means previously mentioned. Moreover, it may be placed in a bath of warm water, and a small stream of cold water poured upon its exposed chest. If the face be swollen and violet-colored, it is better to divide the cord and let one or two teaspoonfuls of blood flow from the child before applying the ligature.

If the child's face be pale, its limbs limp, the prospect for resuscitation is not as favorable as in the case just mentioned; but even then, if there be the faintest, even occasional movement of the heart detected, the attendant should persevere in efforts, which have sometimes been successful even after being continued for an hour. The most important of these means is artificial respiration. In this, or in all other cases, any mucus in the mouth should be removed by a finger covered by a soft piece of linen or muslin.

The nurse, upon receiving the child, should be instructed to lay it on one or the other side, not on its back; and if there should be much rattling of mucus in its throat, it may be held for a minute or two upon its side with its head down, so that this mucus may be discharged from its mouth.

An immature child will be under size and under weight; its face will be small in comparison with the rest of the head, pinched,

and look old; it moves little and feebly, lies with its lower limbs drawn up, has a faint cry or moan; its finger-nails are not fully formed, and it becomes cold and bluish readily. Such a baby should neither be washed nor dressed at first, but carefully wrapped in soft cotton, and artificial heat used as necessary; too weak to nurse, it must be fed at regular intervals.

The first washing of a baby is frequently a violent, protracted, and injurious process. Let its face and head first be washed with warm water, using a soft sponge or flannel, and not, as is often the case, lathered with soap as if they were to be shaved! How often an inflammation of the eyes which follows is a soap-suds inflammation! Let it again be said that soap is unnecessary in washing the face and head, and may be very injurious. The body frequently is covered with a cheese-like matter, and if so, first rub the surface with an egg beaten up with sweet oil, butter or lard, then place the child in a bath of warm water, using soap and sponge, or flannel, and in three or four minutes all the really necessary washing can be done. Even if some of the matter may remain, violent or continued efforts to remove it should not be made, for it will dry up and crumble off at any rate in a day or two.

After the child is washed and dried, the attendant should examine it—the mother is probably anxious to know whether it is perfect, is not marked; its sex she has been informed of previously—and it is well to notice that the openings of the urethra and of the bowel are natural.

Dressing the stump of the umbilical cord is usually done with a piece of linen, which is first scorched, a hole is cut or burned in its centre, and a little mutton-suet applied to the lower side or that which is to be next to the abdomen; the stump is passed through this hole, and the linen folded from below above, and from one side to the other. This makes a cumbrous bundle or mass, and although the cord withers up and falls off in a few days, there generally is a decided odor of putrefaction in the process. A much better way of dressing the cord is this:

Grasp it between the thumb and finger, and cut it off just at the ligature which was applied at birth; now squeeze out all the jelly-like fluid and the few drops of blood in it, holding it firmly to prevent hemorrhage; by this process the cord is reduced almost to a ribbon form, and often is not half its former size; then apply a ligature similar to the first, and with a bandage of soft, thin muslin, an inch broad, cover it, wrapping it around two or three times, and finally fastening the bandage by two or three stands of coarse thread or silk. The advantages of this dressing are a double se-

curity against hemorrhage, for first, when the cord is thus thinned down, the ligature is not nearly so liable to slip; and second, the additional ligature over the bandage; finally, less material to decompose, and therefore, less or no putrefactive odor, and less possibility of the navel becoming sore.

[It may here be said for those who prefer the former plan of managing the navel cord, that the object of the rag is, in part, to absorb the moisture from it. For this reason it should not be greased nor scorched, but simply warmed to insure dryness.—Ed.]

The first article applied by the nurse is what is generally known as the belly-band—this ought to be fastened by strings instead of pins; indeed, as few pins as possible should be used in the clothing of infants; and the greatest danger is in its being fastened too tightly—there ought to be room enough to slip two fingers beneath it, and after a few hours, as the infant's lungs expand more, it ought to be loosened still further. In general, a baby's clothing should be of soft material, for comfort, not for show, and easy to put on and off. After the infant is dressed it should be placed in its bed, or in the mother's bed, but not on her arm or close to her, and covered sufficiently warmly, but not with its face wrapped in a blanket—it needs pure and abundant air to breathe quite as much as it does heat.

There is no necessity for feeding it panada, sugar and water, or anything; the infant, if healthy, its clothing properly put on, and it is comfortably placed, sleeps for a few hours. The mother by this time has also slept, and when it wakes, the infant may be applied to her breast. Although milk is, in most cases, not yet fully formed, the breasts usually have a watery secretion, known as *colostrum*, which acts as a gentle laxative. In a short time the bowels of the child are moved, the discharge being a sticky, dark-green mass, known as *meconium* from its resemblance to the thickened juice of the poppy. This meconium in two or three days passes off, and the discharges from the bowels then become a clear yellow.

An infant should be nursed once in two or three hours in the day, and two or three times during the night. For the mother's sake as well as its own, it should not be applied to the breast every time it has any discomfort, nor be allowed to be incessantly tugging at the nipple, or sleeping with the nipple in its mouth.

The utmost cleanliness should be observed in the prompt removal of soiled diapers, and not reapplying them until they are washed and thoroughly dried. [Want of observance of such care frequently causes the red and inflamed buttocks and genitals so often seen in young infants. Still another cause of this local in-

flammation is the practice of using washing-soda to facilitate the cleansing of diapers and the under-garments worn by infants, the caustic effect of the soda being irritating even to the less delicate skins of grown persons.—Ed.]

Artificial feeding is rarely necessary, and the failure to nurse her infant is often as serious an injury to the mother as it is a great danger to the child. [It is sometimes necessary to resort to artificial feeding, and the directions for doing so may be found on page 467.—Ed.]

In the female economy the ovaries, the uterus, and the breasts are designed to have successive periods of activity, and then of rest. Thus, in menstruation the ovaries are especially active; pregnancy comes and they rest, while the uterus undergoes the enormous development which has previously been pointed out; then at the termination of pregnancy the current of active life sets to the breasts, and the uterus enters upon its period of rest. Not only is this so, but there is a stimulating influence from a child's nursing reflected from the breasts to the womb, arousing it to contraction and hastening its return to its condition prior to conception. Now this orderly succession of nature cannot be broken with impunity; a permanent enlargement of the uterus with various menstrual disturbances may result, or frequent pregnancies break down the patient's health.

If it is necessary, from the condition of the mother's health, to use artificial food, try first *mixed nursing*, that is, let the child get part of its supply from the mother. This artificial food should at first consist of rich cow's milk diluted with two parts of water, and sweetened with white sugar, or, better still, with sugar-of-milk. [See page 461.] Food should not be given with a spoon, but from a nursing-bottle, and it should be warm, brought to the temperature at which nature furnishes milk. An infant, if dependent upon this altogether, will take about a quart in twenty-four hours. The bottle should be well scalded every time both before and after it is used.

Constipation is to be remedied by rubbing the bowels for a few minutes every time the baby has its bath; by warm-water injections; by a suppository of castile soap; by a teaspoonful of olive oil with or without a few drops of castor oil, or by nearly as much sulphur, or a syrup of rhubarb. So far as all but the first one of these remedies is concerned, it is better to use one and sometimes another, thus varying the means and not using the same one every time. [See, also, page 513.]

Diarrhœa in an infant is generally an indication of indigestion, and demands, for a few hours, a change of food; and the milk,

whether from the mother or from the cow, may be replaced by sweetened toast-water and gum-arabic water.

Vomiting is generally the effort of a distended stomach to relieve itself, and suggests a less liberal supply of food. [For further information on this subject, see page 479.]

The shape of the child's head, when the labor has been protracted or difficult, sometimes is a source of distress to the mother; in consequence of the severe pressure it may be elongated like a sugar-loaf, looking indeed very little like a human head. But she

Fig. 206. Fig. 207. Fig. 208.

Figure 206.—The appearance sometimes presented for a short time after birth, when the head of the child passes through the pelvis and out at the vulva in the most usual way, and when the pressure of the surrounding parts has distorted the soft skull and its contents.

Figure 207.—The shape which is usual for the head of a child when its breech is the part first delivered

Figure 208.—Appearance of a child when the forehead was the part of the head which first escaped through the openings of the uterus and vagina.

may be assured that, without any molding at the hands of the nurse, nature in a few days will set the head right; that the type according to which it was designed will be faithfully worked out, and all the apparent deformity disappear.

A deformity of the head slower in disappearing is caused by an effusion of blood beneath the scalp. The tumor is soft, often quite

large, and generally upon the right side; sometimes upon both sides; rarely on the back or on the front. It disappears, as a rule, in from ten to sixty days, even though no treatment is pursued; very rarely is it advisable or even proper to open such a tumor; bathing the swelling twice a day with a wash of alcohol or of sal-ammoniac with water, in the proportion of twenty grains to a cupful of warm water, is all that is usually necessary.

After the falling off of the navel-string, occasionally a raw surface is left; cleanliness, dusting with dry calomel, or lightly touching it with a solution of ten grains of nitrate of silver in an ounce of water, will usually cause it to heal.

Sometimes, at the navel, instead of a depression, a round elevation occurs. This is a "rupture," an umbilical hernia. It can generally be cured by taking two strips of isinglass plaster, three inches long and half an inch broad, and making a Grecian cross, the centre of which corresponds with the swelling. In applying

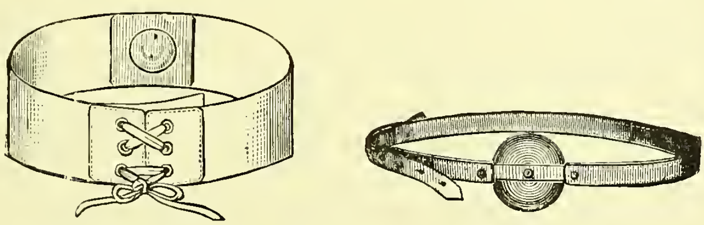


FIGURE 209.—Varieties of trusses suitable for rupture of the navel in infants.

the strips, after moistening one of them, fasten about one-third upon the skin near the rupture, then draw upon the skin so as to make a fold which shall cover the projection, and press it in as the strap is carried over and fastened upon the other side; then the second strap is to be applied so as to cover this at the centre and assist it. Of course, this dressing must be frequently renewed.

Another plan is to have a convex button or piece of cork covered with buckskin, so as to be just the size of the hernia; press the rupture in, and prevent its protrusion by the button fixed in place by means of the belly-band or a strip of isinglass plaster.

Infants, when a few days old, may become tinged a dusky yellow color, but the whites of the eyes are natural, and not yellow, nor does the urine stain the diapers, nor are the operations from the bowels clay-colored. This discoloration is due to a sort of jaundice caused by derangement of the function of the liver, in which the circulation of the blood is different after birth from what it was before the child was born. This condition requires no treatment, and very soon passes away.

So too, the great majority of cases of true jaundice—in which the whites of the eyes are yellow, the urine orange-colored, and the stools looking like soft putty, are not serious. Careful attention to bathing, a laxative dose or two of castor oil, possibly a little bicarbonate of soda and sweet spirits of nitre, as follows :

Bicarbonate of soda	20 grains.
Sweet spirits of nitre	20 drops.
Sweetened water	2 teaspoonfuls.

This may be given, half a teaspoonful at a dose, as often as every six hours, and the trouble will commonly soon disappear.

In a few instances, however, the disease is more serious in character, and may be attended with hemorrhage from the navel. Five out of six cases of this grave form of jaundice die. When hemorrhage from the navel occurs in an infant, whether jaundice does or does not exist, a compress of cotton cloth, linen or lint, dipped in strong alum-water, may be applied, or a solution of muriated tincture of iron of the strength in which it is procured from the druggist, may be used in the same manner, and repeated at intervals of half an hour until bleeding stops, or finely powdered plaster-of-Paris may be put upon the navel and kept in place by a bandage. Other measures may be resorted to by a physician, who should always be summoned in these cases, as the bleeding often proves troublesome to manage with the best resources.

Scalding or chafing is to be prevented by cleanliness, and if it occurs, to be cured by keeping the surface dry, and dusting it with finely powdered starch, or with equal parts of powdered lycopodium seeds and powdered starch.

[When a movement of the bowels does not occur within the first twelve hours after birth, a careful examination should be made to determine whether there is not a closure of the bowel. This closure may sometimes be at a little distance from the surface, and *may* be a cause of the trouble. This subject will be also mentioned in the chapter on the Anus and Rectum, in Vol. II.

It sometimes happens that shortly after, the birth of a child, urine is passed which stains the diapers of a reddish or orange yellow color. This condition is usually attended by crying and other evidences of pain or discomfort on the part of the infant, and may excite some alarm among the attendants. It is caused by the discharge from the tubules of the kidneys of a quantity of uric acid crystals, which have accumulated in excess of the watery portion of the urine, in which they are ordinarily dissolved, and are at this time washed out by the secretion of urine, which is greatly increased as soon as the child is born. The application of a warm

poultice of corn-meal or flaxseed meal over the back and belly will relieve the sense of discomfort, and nothing further is needed to be done, as the cause of trouble soon passes away.—Ed.]

Let us now resume the attention required by the mother: Lying upon the back, with the head and shoulders slightly elevated, facilitates the discharge which should come from the womb, and therefore is advantageous; it is not necessary that it should be rigorously adhered to, but occasional changes to one or the other side may be made as desired. It is important that she should be kept quiet, and that very bright light, noise, and fatigue should all be avoided, and few or no visitors permitted. When visits are unavoidable, they should be brief.

One of the mother's first positive sufferings, and often a very severe one, may be from *after-pains.* [These may follow a first labor, though this is not usual, while it is the rule for them to occur with subsequent labors, and for them to increase in severity with each recurring delivery.

The cause of these after-pains is the irregular contractions of the uterus which take place after the delivery of the placenta, and it will be found that they are usually attended with the expulsion of more or less blood in clots. When the third stage of labor, or the delivery of the after-birth, has been properly managed, these pains may frequently be mitigated, or altogether prevented.—Ed.]

Treatment.—A half-teaspoonful of fluid extract of ergot, given with a little cold water just at the close of the second stage, will often prevent after-pains by insuring firm contraction. Sometimes they may be relieved by a poultice, or by cloths wrung out of hot whiskey, upon the abdomen; but frequently it is necessary to give an opiate, and to repeat the dose once or oftener; twenty drops of laudanum, for example, may be given, and repeated in an hour if the pain persists.

The patient should be urged to *empty the bladder* within twelve hours after the termination of the labor; and, if she should not succeed, the urine should be drawn off with a catheter. This operation must be repeated twice in twenty-four hours until the patient can herself empty the bladder. A resort to this instrument must be had much sooner and oftener in every case when, from delay in the second stage, the head is *impacted*, as it is termed. In such cases there is sometimes such pressure on the bladder that danger of sloughing of this organ exists, and the consequent formation of an opening between it and the vagina; and it is essential that the walls of the bladder should be relieved from any strain owing to the collection of urine in its cavity, for the possible prevention of this accident.

The bowels need not be moved before the third day; and this may be accomplished by an injection of a pint of flaxseed tea or of barley-water, or by half a tablespoonful of castor-oil taken by the mouth. [See "Castor-Oil" in the Index, for directions which will facilitate its administration.] But if the flow of milk be considerable, a saline is preferable, such as a Seidlitz powder, Rochelle or Epsom salts; remembering that, as a rule, a woman recently delivered will have her bowels readily acted upon, and therefore the dose should be smaller than usual.

The discharge that flows from the womb during the first twenty-four hours after labor is blood; often some clots are mixed with the liquid; it then loses by degrees its red hue, and becomes more watery. From the third to the fifth day it gets thicker, assumes a milky and purulent appearance, and acquires a peculiar odor. This flow is more abundant and lasts longer in women who do not nurse. It diminishes, and sometimes stops entirely for a few hours, at the time when the secretion of milk is fully established, but soon is again free, and usually ceases entirely at the end of two or three weeks.

The chief variations in regard to this discharge are its suppression, the acquisition of a very offensive odor, and its again becoming bloody after having passed through the changes previously mentioned. The last condition generally happens from a patient's getting up too soon, or being on her feet too much, and it is then simply an indication for keeping in bed for a longer time.

When the discharge is offensive, washing out the vagina twice a day with a warm tea of chamomile flowers, or with carbolic acid, or permanganate of potash, dissolved in warm water, may remedy this matter;* but in some cases it will be advisable to apply the

---

* [*Chamomile Tea:*

Chamomile flowers........................ half an ounce.
Boiling water.............................. one pint.

Allow them to steep for ten minutes in a covered vessel, and then strain through a cloth or sieve.

Carbolic Acid Wash:

Carbolic acid (purified).................... half a teaspoonful.
Alcohol.................................... a tablespoonful.
Water...................................... two pints.

Mix the carbolic acid well with the alcohol, and then add the water.

Permanganate of Potash Wash:

Permanganate of potassium.............. sixty grains.
Water..................................... half a pint.

Dissolve the permanganate in the water, and when a wash is needed add a cupful of the solution to a pint of warm water.—ED.]

injection to the inside of the womb, and this should only be done by a physician.

Suppression is oftener the effect than the cause of mischief, and is more frequently partial than complete. Stimulating applications to the abdomen, especially turpentine stupes, warm drinks, and the same injections that are advised when the discharge is offensive, will frequently be useful.

Should the discharge cease in a week or even less time, after labor (as it does in some instances), and no unpleasant symptoms precede, accompany, or follow it, no treatment is necessary.

Care of the Breasts.

The third day after confinement there may be a little chilliness, followed by a few hours of feverishness, a frequent pulse, thirst, and headache. This is what is generally known as *milk-fever*, though it is irrational to believe the establishment of a natural secretion can cause fever.*

Coincident with the symptoms just mentioned there is swelling of the breasts, and they become not only larger, but harder and quite sensitive, and are the seat of throbbing and shooting pains. If nature's instincts are obeyed, and if nature's examples, as furnished by the young of mammals generally, are imitated ; if the infant, which almost as soon as it is born makes the motions of sucking, is placed at the breast (as soon as the mother is rested), and a repetition of this nursing permitted every few hours, the so-called milk-fever will not [usually] be known. When the breasts become swelled and painful, the patient, as previously suggested, may take a saline laxative. The amount of fluid which the mother drinks may be diminished, and she may live chiefly on

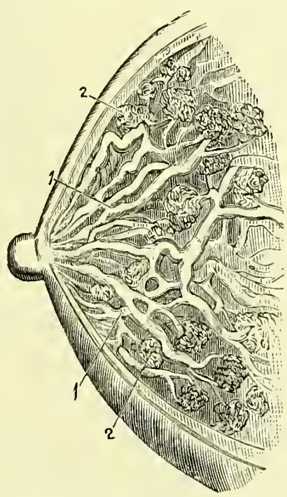


FIGURE 210. — A section through the breast showing the arrangement of the milk-tubes (1, 1), and the lobules of the gland (2, 2), in which the milk is formed.

[* It is more reasonable to infer that this disturbance of health is due to the absorption of decomposing matters from the uterus and vagina, through the lacerations in the mucous membrane, which almost always occur to some extent, in the stretching of the parts during delivery. When care is taken to prevent the retention of decomposing matters by the use of the lotions and the precautions just mentioned, this feverishness is not so liable to occur.—ED.]

solid food. Thirst may be quenched with small pieces of ice, and the breasts may be bathed with any warm fluid, such as a tea of hops, or with sweet oil. But after all, the thing of prime importance is to empty the breasts, or at least to relieve their distention, by the infant's nursing. In consequence of the great swelling of the breast, the nipple is, as it were, partially buried ; is much less prominent than before, and hence it is difficult for the infant to

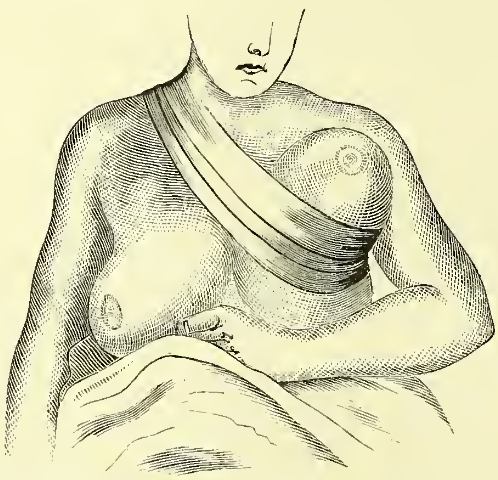


FIGURE 211.—Mode of supporting the breast by means of strips of adhesive plaster long enough to meet and cross on the back.
This measure is often productive of much comfort to the patient when the breasts are swollen, and a bandage of muslin or flannel may be used instead of adhesive strips.

get it in the mouth. Fomenting the breasts with flannel wet with hot water, gently rubbing them, and then drawing the nipples out with a breast-pump will usually obviate the difficulty. Sometimes when the nipple is much sunken or retracted, a glass, wood or metallic shield with an india-rubber teat will be useful ; or an older child, or an adult who preserves the usually lost art of infancy, may be called in requisition to draw out the nipple.

The mother should at first nurse while lying on her left side, so that when the left breast, for example, is used, the nipple will drop into the child's mouth. If the infant is laid upon her, so that its nose is buried in the breast, breath-need will conquer hunger-need, and it will get very little nourishment. As she gets stronger the mother may sit up while nursing.

The nipple should be bathed in cold water before and after giving it to the baby ; but if the skin be tender, it is well to use after each nursing a wash of alcohol and water, or some astringent solution. In all cases the nipple should be thoroughly dried, and not

left with a warm water poultice on it, the tendency of which is to soften the skin, and prepare the way for fissures and ulcers ; similar mischief is done, too, by letting the infant dally and delay in sucking, soaking the nipple in its mouth.

[Two reasons exist for carefully washing the nipples before and after nursing : 1. If the milk is allowed to remain in the folds and depressions on their surfaces, it rapidly becomes sour and acts as an irritating substance upon the delicate skin. It may thus cause them to become tender and inflamed. 2. When the infant is again put to the breast, and this sour and rancid milk is taken into the stomach along with fresh milk, it is liable to set up in the latter the process of lactic-acid fermentation, and bring on an attack of indigestion.]

Sore nipples are frequently the cause of much agony to the mother whenever the child nurses, and are the almost sole causes of inflammation and abscess of the breasts, and therefore all possible means should be used for their prevention. Let the reader be again reminded of the care of the nipple in pregnancy ; of avoidance of compression, of means to insure its having a proper form, of scrupulous cleanliness, and of the use of agents to harden the skin. Let her also remember the advice given as to early application of her child to the breast, and the absolute avoidance of all the abominations that may be poured down an infant's throat in the first day or two, by which it is so stuffed, that it does not care to nurse, or so agonized with colic and consequent catnip that it cannot.

If the nipple should become sore, let the raw surface be brushed two or three times a day with the compound tincture of benzoin, or with a solution of ten grains of nitrate of lead, or fifteen grains of tannin in an ounce of glycerine. A piece of patent linen, dipped in a similar solution of sugar of lead, may be kept on the raw surface, but it should be borne in mind that the nipple must always be carefully washed before giving it to the infant, when applications of lead solutions are made.

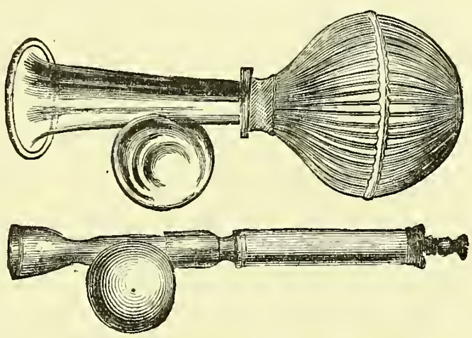


FIGURE 212.—Varieties of breast-pumps in common use.

A nipple-shield (see Vol. II) will be advisable ; so, too, giving each nipple as long a *rest* as possible—that is, at one nursing use one breast only, and make the interval as long as possible.

If fissures are formed, cauterizing them with a very fine point of nitrate of silver is generally the best treatment. Nevertheless, should pain, tenderness, swelling, and redness occur in the breast, nursing from it should be stopped; it must have absolute rest, or an abscess is probable.

[Among women who are of a nervous temperament; who are anæmic; who suffer from malarial poisoning, or who are not well nourished, it is not infrequent that the application of the infant to the breast causes an intense pain of a neuralgic character, resembling that which is produced by a fissure of the nipple, and which is often mistaken for the latter. This mistake is the more liable to occur when the nipples have naturally deep folds in their surface, and the latter are thought to be *fissures*, which really may not exist. Such cases are readily relieved by a resort to quinine, iron, bitter tonics, warmth, change of residence to a healthier locality, or to the sea-shore, and by such other measures as are calculated to improve the general health, and are best determined by a physician.—Ed.]

In inflammation of the mammary gland, which in nine cases out of ten is the result of sore nipples [or neuralgia of the breasts] and rarely, if ever, is the direct consequence of over-secretion of milk, the treatment would be a diminished amount of fluids to be taken by the patient, saline cathartics, support for the breasts, and, as a local application, either flannel cloths wrung out of water as hot as can be borne, or an ice-bag—whichever is the more agreeable to the patient—for heat and cold will each produce contraction of blood-vessels, according to the way in which they are employed, and thus diminish the inflammatory action.

The patient need not be tormented with leeches, blisters, or nauseating medicines, but warm poultices must be used, if the formation of matter is found to be inevitable. The advice of a physician will also be required.

In case the milk is scanty, attention to the patient's general health is all-important, and then the abundant use of nutritious fluids, such as chocolate prepared with rich cream, fresh milk and animal broths, promises as much as to quantity, and more as to quality, than swilling teas, wines, and beer, in which there is little beside mere liquid to increase the milk.

If the infant be still-born, the patient may be anxious to have something to repress the formation of milk, having before her the horror of a "gathered breast." But let her be assured that milk does not make matter, and that it generally is one of the most polite of visitors—if not wanted, it will retire.

When the milk fills the breast, merely draw enough to relieve

the distention, and no more, but do not use violence in this process. Gently bathe the breasts with equal parts of sweet oil and spirits of camphor, and in the intervals let the breasts be covered with a thin flannel wet with spirits of camphor. A saline laxative [such as a Seidlitz powder, or a half-pint to a pint of citrate of magnesia solution] may be given, and the diet be chiefly solid.

After the second or third day, provided the patient be in good condition and the lochial flow is not excessive, the patient may be lifted into an easy-chair, and sit there while the bed is being made. The sacred "ninth-day" for sitting up, has nothing sacred about it but a popular prejudice. One woman can get up more safely at five days than another at fifteen. Certainly, early exposure and fatigue should be avoided; and while the lochial discharge continues, the patient had better not go out.

Let her remember, too, that the process of *involution* of the uterus—that is, the return of this organ to the condition which existed prior to pregnancy—usually requires about six weeks for its accomplishment; and that during this period any great exertion, lifting heavy weights, walking far, or even being on her feet for a long time, or exposure to great changes of temperature, may interfere with the process referred to, and entail upon her many years of needless suffering.

[Apparent Death.

It is not infrequent that infants are born in a condition of suspended animation resembling death. This commonly results either from too long-continued pressure on the head during a slow delivery, or from similar pressure on the cord, such as is most likely to take place when the breech of the child is the part first born. In the former case the child is limp and pale, and its heart is feeble or nearly motionless. When this condition results from pressure on the cord, the features of the child are dusky or purplish; it makes no movements at breathing, and its pulse is feeble.

The treatment of the first variety consists in inverting the child, so that its head will hang downward, and wrapping it in warm flannels to retain its heat. It is rarely, however, that it can be resuscitated if its heart's action has become very feeble. The second variety resembles suffocation or asphyxia, and the methods to be pursued will be found in the chapter on Accidents and Emergencies, towards the end of this volume.—Ed.]

THE DISEASES OF THE PREGNANT STATE.

Morning-Sickness.

The milder cases of morning-sickness will often be relieved by putting a wet compress over the stomach, renewing it every two or three hours, and wearing it from first rising until afternoon. Again, a cup of strong coffee or tea, with a slice of toasted bread, may be taken in the morning before getting up.

Other means are iced carbonic-acid water or champagne ; or small fragments of ice swallowed whole without being allowed to melt in the mouth ; or one or two tablespoonfuls occasionally of equal quantities of lime-water and milk ; or pure cream, frozen ; or one-half to one teaspoonful of aromatic spirits of ammonia in one or two wineglassfuls of sweetened water or milk ; or the application of a mustard-plaster over the stomach ; or the injection into the bowel of one-third to a half teaspoonful of laudanum in half a teacupful of warm starch-water ; or *one* of the following compounds :

Chloroform	3 to 5 drops.
Cold water	1 tablespoonful.

To be stirred and taken at once.

Bicarbonate of potash	5 to 10 grains.
Laudanum	5 drops.
Spearmint-water	1 tablespoonful.

To be taken for one dose.

* *Dilute* hydrocyanic acid	2 to 3 drops.
Subnitrate of bismuth	20 to 30 grains.
Sweetened water	half a wineglassful.

For one dose.

The use of morphia by the mouth, or applied to a small blistered surface over the stomach, or injected in solution under the skin, has sometimes to be resorted to, but should only be undertaken by the advice and direction of a physician.

If constipation accompanies the vomiting, it should, of course, be corrected ; and when the vomited matters are sour, some antacid like calcined magnesia in teaspoonful doses will then be useful.

* This prescription should not be given except by a physician or a competent druggist.

Constipation.

This can generally be prevented, as pointed out elsewhere, by a proper regulation of diet, and by observing a regular time each day for the evacuation of the bowel. If other measures are necessary, a teaspoonful of table-salt in a tumblerful of cold water before breakfast, or a teaspoonful of calcined magnesia at bed-time may be all that is required.

When the tongue is very much furred, five or ten grains of blue-mass, followed in about four hours by five grains of rhubarb and a teaspoonful of calcined magnesia, may cause a better condition of the evacuations. Another remedy may be found in prunes which have been stewed in a tea made with senna-leaves.

Diarrhœa.

Diarrhœa generally arises from indiscretion in diet, or exposure to cold, and requires rest, liquid nourishment, and an opiate ; the last preceded, it may be, by a gentle laxative such as castor-oil with a few drops of laudanum.

Salivation.

Salivation is by no means a constant, hardly a frequent disorder of pregnancy, and generally yields, if any treatment is required, to holding pieces of ice in the mouth, and to astringent washes, such as alum, tannin, or tincture of myrrh in water.

Piles.

Hemorrhoids or Piles are frequently a great torment in pregnancy, and they may be connected with either constipation or diarrhœa. In case the piles are associated with the former, the following pill is serviceable :

Aloes	1 grain.
Extract of henbane	1½ grains.
Pulverized ipecac	¼ of a grain.
Castile soap	1 grain.

One such pill, to be repeated night and morning, is generally sufficient to promote an easy, free, daily evacuation of the bowels ; in some cases half a pill will answer.

If there be diarrhœa, half a grain of opium may be substituted for the henbane and ipecacuanha. [See note on page 442.]

Enlarged Veins.

Enlarged veins of the lower extremities, if great, constitute a serious inconvenience, and may be a positive danger. It is advisable, when lying down, to have the swollen limbs raised somewhat higher than the body, and, when sitting, to have them at least on a level with the chair. The occasional application to the enlarged vessels of patent lint dipped in a solution composed of one part of the muriated tincture of iron, to ten parts of cold water, and, above all, the use, whenever on the feet, of a laced stocking, or better still, because more comfortable, a flannel bandage properly applied, first the foot, and then the leg and thigh, if necessary, being firmly wrapped, will be proper treatment.

Occasionally a similar enlargement of the veins is observed of the external organs of generation on one or both sides. Here little can be done but frequently lying down, and while on the back pressing with the hand the blood out of the veins. In some cases it may be advisable to wear a compress and bandage.

Swelling of the Lower Limbs.

Dropsical swelling of the lower extremities, a white uniform enlargement, especially noticeable in the evening, and capable of being indented by pressure, requires a similar treatment, when it exists alone, to that of varicose veins; but if the swelling is found also occupying the upper extremities; if the face is swollen, pale, and puffy, the case is more serious and demands immediate professional attention.

Dropsy of the external organs of generation may be treated by rest and cold applications.

Difficulty of Breathing.

This generally results from the great development of the uterus, its size interfering with the descent of the diaphragm, or it may be from an impoverished condition of the blood.

Treatment.—If from the first cause, the cure can come only with delivery; if from the second, the patient should have a more nutritious diet, and tonics should be given, especially iron.

Fainting.

This sometimes is frequent during the first three or four months. Generally it results from some unusual exertion or excitement; from a close room, strong odors, etc.

The treatment should be the recumbent posture, with the head quite low—if lower than the body, so much the better—loosening the clothes about the throat and chest, fresh air, the inhalation of ammonia, or camphor, etc., and a stimulant, such as a teaspoonful of aromatic spirits of ammonia in sweetened water.

Neuralgia.

This may take the form of toothache, without sufficient decay of the affected tooth to explain the pain, and is then one of the severest torments occurring in pregnancy.

[It has been noticed in pregnant women, whose digestive organs do not furnish to their blood enough material from which the growth of the child can be supplied, that the fat and mineral salts which have already been formed into the structure of the mother's body become a source of supply. The teeth as well as softer structures lose a portion of their minute substance and often undergo changes which may be seen by the eye. At this time decay is more rapid, and women whose teeth at other times may give them no especial inconvenience, find that they suffer from loosening of fillings, formation of fresh cavities and, more often, from toothache, the cause of which cannot be seen, but which probably is the loss of substance above referred to.—Ed.]

Treatment.—Warm applications, such as hop poultices (see Vol. II.), laudanum, and warm water, etc., or chloroform may be used ; and if the pain be periodic, then in the interval give every hour, until ten are taken, a pill composed as follows :

Sulphate of quinine	2 grains.
Extract of belladonna	$\frac{1}{10}$ of a grain.
Opium	$\frac{1}{8}$ of a grain.

If the patient be weak and feeble, in addition to a proper diet, she could take with advantage the following made into a pill, which may be repeated :

Sulphate of quinine	2 grains.
Dried sulphate of iron	$\frac{1}{2}$ grain.
Extract of henbane	$\frac{1}{2}$ grain.

three times a day. This treatment to be continued for a month or more.

[In neuralgia caused by impoverishment of blood, above referred to, two-teaspoonful doses of syrup of the lacto-phosphate of lime, taken at meal time, may be of service in relieving the difficulty.—Ed.]

Where a tooth aches from decay, and the disordered condition of the stomach sometimes hastens such decay, the same treatment should be pursued as advised by an intelligent dentist were the patient not pregnant. But before so severe a remedy as extraction is resorted to it should be certain that the aching tooth is really diseased, and so diseased that it cannot be cured.

Discharges from the Vagina.

These may be bloody, watery, mucous, or of mixed mucus and pus. In regard to the first, those which occur at what would be a monthly period, if the patient were not pregnant, and which are frequently cited as illustrations of menstruation during pregnancy, very probably should be regarded as simply threatening miscarriage, and demand the treatment of that condition.

Watery discharges coming with a sudden gush, and then for a while with slow dribbling, are sometimes noticed in the latter months of pregnancy, and are frequently mistaken for rupture of the fœtal sac. Their source is probably from between some portion of the external surface of the fœtal membranes, and the internal surface of the uterus.

They require no treatment, save rest, for possibly they may lead to premature labor.

The *mucous* variety of discharge, usually termed leucorrhœa, or whites, may be treated, if profuse, by vaginal injections once a day of carbolic acid soap-water, and once a day of a solution of borax in water, three drachms to the pint; but in regard to all vaginal injections used by pregnant women, two things should be remembered, that it is necessary to have their temperature near that of the body, and that it is unsafe to use them with force—they are not douches, but simply gentle washes: a syphon syringe will avoid the latter of these dangers. (See also, Chapter on NURSING.)

Itching, or Irritation of the External Organs of Generation.

This is often associated with leucorrhœa, especially if the latter is profuse, but may also exist without noticeable discharges of any sort.

Treatment.—This itching may generally be relieved by washing freely with the solution of borax just mentioned above (three teaspoonfuls to a pint of water), or by a wash of sugar of lead, of the strength of a drachm to a pint of water, or by flannel cloths wrung out of hot water, or by the following liniment

Laudanum	½ ounce.
Chloroform	½ ounce.
Glycerin	10 ounces.

Sometimes lightly cauterizing the itching surface with lunar caustic is very efficient, but this operation should only be done by a medical attendant.

Disorders of the Bladder and Urine, and Uterine Displacements.

The disorders of the bladder incident to pregnancy are irritability and incontinence, and retention of urine. The first is generally the result of neglect, though sometimes the consequence of uterine displacement, and rarely it may be the cause of such displacement.

In any case it may require professional aid. It is well to follow the rule of evacuating the bladder every six or eight hours.

When there is irritability of the bladder independent of any alteration in the character of the urine, relief will often follow the use of the following:

Extract of henbane	½ grain.
Camphor water	2 ounces.

Incontinence of urine, or its unconscious escape, is generally the result of pressure by the uterus on the bladder, and the best relief is from lying down, especially with the hips somewhat elevated; and when up, if the abdomen is pendulous (the uterus falling forward), by a properly adjusted bandage correct this displacement.

The two most serious displacements of the uterus which may complicate pregnancy, are, *first*, complete prolapse or descent of this organ—the uterus coming externally, or, *second*, tipping of the uterus backwards. Each of these, however, is so serious, threatening the abrupt arrest of pregnancy, that professional advice should be at once sought.

Miscellaneous Derangements.

So too, any *serious impairment of sight*, or *violent pains in the head or stomach*, and especially the association of them, may be the indications of grave disorder of the kidneys, and be the forerunner of convulsions; hence these symptoms also urgently require medical advice.

Abortion and Miscarriage.

Abortion is the discharge of the product of conception before the expiration of six months; *miscarriage* is frequently used in

the same sense, though formerly a distinction was made between the two. Respecting the frequency of its occurrence, the common estimate of one abortion to three or four labors, is probably too little rather than too great.

Causes.—This accident is more likely to happen in those who menstruate profusely, and in very fat women who, however, are less liable than others to become pregnant.

Hereditary influence is sometimes a cause; habit is often one. Syphilis is a frequent cause, and so are such diseases as measles, scarlet fever, and especially small-pox; diarrhœa and dysentery may cause it, and so too, may pneumonia or typhoid fever, but only when the disease is so serious that the patient's life is in peril. Intermittent fever is occasionally a cause. Among other causes may be placed violent mental excitement, irritant purgatives, displacements, inflammation and tumors of the womb, violent exercise, great fatigue, falls, blows, severe vomiting, sexual indulgence, impure air, abrupt changes of temperature, etc. Abortion is most liable to occur in the first three months.

The symptoms of abortion vary somewhat with the period of pregnancy. When in the first six weeks, they are in most respects similar to the suffering that many women have at menstruation. The patient complains of "feeling badly;" of loss of appetite; of irregular chilly sensations and flashes of heat; she has backache; she has sensations of pain, weight, fulness in the lower part of abdomen and pelvis, uneasiness in bladder and bowel, and pains in the groins. These symptoms are aggravated by standing or walking. There is loss of appetite, and the pulse is fuller and more frequent.

These premonitory symptoms may last some days, or be entirely absent; but in either case there is usually a sudden discharge from the womb of a watery fluid, sometimes tinged with blood; often this discharge is painless, but, whether so or not, pain soon becomes a prominent feature; with the pain comes a flow of blood, and though the amount of blood lost may not be great, the pain and flow continue until, with some clots of blood, the ovum is discharged. Often the suffering is no greater than at menstruation, and with the best faith in the world many a woman will assure the physician that she has never been pregnant, when the truth is she has aborted time and again.

In the third month there are the same premonitory symptoms, and the chief differences in the progress of the disorder are the much greater hemorrhage, and the pain being of an intermittent character, that is, occurring at regular intervals like the pains of ordinary labor. When abortion occurs about this time there is a

greater liability to a retention of a part of the ovum, and as a consequence the constantly impending dangers of hemorrhage, or poisoning of the system from decomposition of clots, etc., retained in the uterus. Hemorrhage alone is very rarely a cause of death in abortion.

Criminal abortion is attended with peculiar dangers—first, from the violence frequently used in its production, and, second, concealment leads to want of proper care ; it frequently is a cause of death, and human society should hold the man or woman who is engaged in this infamous business, a murderer, even if the victim should never be other than a helpless embryo.

When abortion occurs at from five to six months, its history is similar to that of labor.

Treatment.—In the treatment of abortion, the first object should be to prevent the accident, and this prevention should be exercised in anticipation of its possible occurrence. It is not necessary to recapitulate the preventable causes of abortion previously mentioned, or to present the treatment appropriate to each. One agent, however, which is of the utmost importance, more particularly in habitual abortion, is *rest*, especially at the time when abortion has previously occurred. Not only should this rest be general and include a recumbent position, but also *physiological*, for here, if ever, it is the physician's duty to peremptorily insist upon abstinence from sexual intercourse.

When the positive threatenings of abortion occur, the patient should at once lie down on a moderately hard bed ; have the head low ; be lightly covered, and use cold acid drinks ; if there be much pain, and especially if the pains are intermitting, they should be arrested, if possible, or at least relieved, by injection into the rectum of twenty to thirty drops of laudanum and half a teacupful of starch-water, repeating the injection once or oftener at intervals of two hours. But should hemorrhage and pain persist in spite of the treatment, or, at any rate, if these are severe, a physician should be sent for. An effort may be made in the meantime to check the flow by cold applications upon the abdomen, or astringent injections into the vagina.

It is important that all discharges that may occur from the womb, even if they appear to be nothing but clots, should be saved for inspection by the physician, so that he may know if and when the entire ovum has passed.

The importance of rest after abortion cannot be too strongly insisted upon. The patient should maintain this rest as faithfully as if she had been delivered of a living child, and she will thereby run much less risk of immediate danger, and the greater risk of

years of suffering with various uterine disorders, such as inflammation, displacement, etc.

Premature Labor.

Premature labor is the expulsion of the fœtus at any time after the commencement of the seventh month and before the end of the ninth month. At seven months the child is said to be *viable,* that is, able to live outside of its mother's womb. Occasionally a child born at an earlier date may live, but such an event is quite exceptional.

There is a popular notion that a child born at seven months has greater *viability* than one born at eight. Indeed, this irrational opinion ruled the professional mind for hundreds of years from the time of Hippocrates. It had its origin in a falsé theory of child-birth, the belief being that the child always got out of the womb by its own efforts; and these efforts it made at monthly periods, commencing at seven months. Now, if it succeeded in getting out at seven months it was unusually strong, and theretore likely to live; but if it escaped at eight months it was fatigued by the previous exertion of seven months, as well as that of eight, and was not so viable.

Causes and Symptoms.—Premature labor is produced by many of the causes that result in abortion, and therefore these need not be detailed. Its phenomena are similar to those of labor at full term, and its management the same as that of such labor.

Molar, or False Pregnancy.

Women sometimes, after having most of the ordinary symptoms of pregnancy up to the third or fourth month, find that the abdomen no longer enlarges, and presently they are taken with the indications of abortion; then, after considerable pain and hemorrhage, they discharge a fleshy mass, often about the size of a hen's egg. Upon examining the interior of this, a small cavity is found, lined with a smooth membrane; the cavity frequently containing either a small embryo, or else a vestige of the navel cord. This is sometimes called a false pregnancy, but originally it was a true one, and the mass discharged is simply a blighted ovum, and is called a fleshy mole.

Again, a woman has all the ordinary symptoms of pregnancy up to four or five months, but no fœtal movements are discovered —no fœtal heart-sounds heard. But the abdomen enlarges with great rapidity, and its development is much more than it should be

at the corresponding period of true pregnancy. Then comes a gush of bloody serum, possibly a severe hemorrhage, and in the fluid are little clusters of bladder-like bodies, almost like bunches of white currants or grapes. This is known as the hydatidiform, or vesicular mole.

The former is much the more frequent variety of molar pregnancy ; and it, unlike the latter, is comparatively free from danger.

Flooding.

Copious Hemorrhage or Flooding, as it is expressively termed, may occur from rupture of an enlarged vein in the external organs of generation, or from detachment of the placenta.

In the former case, well-directed and firm pressure will arrest the flow. In either case the patient should be in a horizontal position, with the head low, and, if very weak, stimulants with twenty or thirty drops of laudanum may be advisable, though sometimes the faintness may, for the time, stop the flow. A physician should at once be sent for.

Death of the Fœtus.

The causes of this have been mentioned among those of abortion. Its evidences, though not absolutely conclusive, are cessation of motion ; inability to hear the sounds of the fœtal heart (they having previously been heard); the abdomen ceases to enlarge, and the breasts, before tense and full, become smaller and flaccid ; the patient's health may suffer, and she may complain of irregular chills, and loss of appetite. Generally in eight or ten days after its death, the fœtus is expelled, though sometimes the expulsion is delayed until the completion of the nine months.

Twins.

Double or twin pregnancy occurs once to seventy or eighty single pregnancies. Hereditary influence either on the part of the mother or of the father seems to be an occasional cause.

Can a pregnant woman know in advance that she will give birth to two children ? If, having previously borne children, she finds herself much larger than at the same time in former pregnancies, if the enlargement be not uniform, but divided in the middle line of the abdomen by a depression, presenting a little the appearance of a pair of well-filled old-fashioned saddle-bags, and apparently different and distinct motions are felt in these two halves of

the abdomen, there is a strong probability she is pregnant with twins. The unusually great distention of the abdomen in the latter part of pregnancy causes greater difficulty in breathing and in moving; so too, swelling of the lower extremities will be more; often, too, the upper limbs are also swollen, and the face more or less bloated.

In nearly two-thirds of the cases of twin pregnancies, the children are of the same sex, and their sex a little oftener male than female.

FIGURE 213.—Position ordinarily assumed by the fœtuses in twin pregnancy. The membranes enclosing them are represented as having been cut away, but it will be seen by tracing out the outlines of the partition between them, that each fœtus is contained in a separate amniotic sac. Although the navel cords are represented, the after-births are not shown.

In consequence of the great distention of the womb, when labor sets in the first stage is apt to be protracted, the pains not so strong, and separated by longer intervals. When this stage is completed and the bag of waters ruptured, the uterine contractions become vigorous, and the second stage is frequently terminated in less than the usual time. In more than one-third of twin-labors each child

descends with the head first; next in frequency, we find the first child presenting the head, and the second the breech. Generally the second child is born within fifteen or twenty minutes after the first. Nevertheless, in some cases, an interval of a few hours may separate the births, and an instance is recorded where this interval was prolonged to ten days.

Hemorrhage is a little more liable to occur after delivery of twins, and therefore all proper precautions should be taken to prevent this accident; such as having the head low, securing perfect contraction of the womb by compression with the hand, by a suitably applied bandage, and, if necessary, by ergot.

Protuberant Abdomen, or Large Belly.

The abdominal walls after their great stretching in single, still more in twin pregnancy, may be slow in returning to their ordinary size, but remain flabby, relaxed and projecting. In ancient times when a woman knew herself pregnant she went to the temple of Diana, depositing her girdle there, and assumed looser garments adapted to her condition. It is hardly probable that the women of to-day will entirely lay aside their corsets during pregnancy, or that they will hesitate to resume them upon leaving the

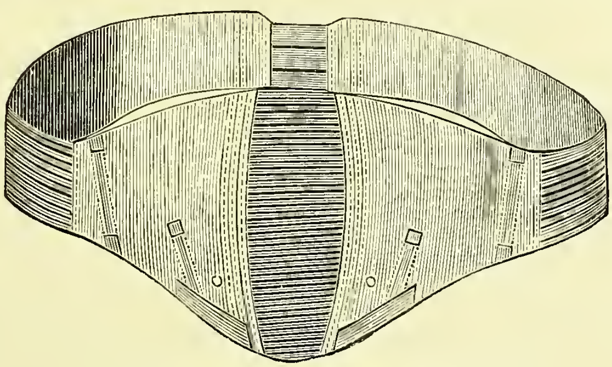


FIGURE 214.—Abdominal bandage with elastic bands.

lying-in room. A properly made corset furnishes excellent support for the breasts; but if it be laced at all tightly, injurious compression of the chest, and consequent encroachment upon the cavity of the abdomen result. Of course such encroachment causes the abdomen to project more, and she finds herself presenting that appearance sometimes described as pot-bellied. To remedy this condition—at once a discomfort and a deformity—avoid tight lacing, sponge the abdomen daily with cool salt water, rubbing it

thoroughly and until quite dry, do not let either the bladder or the bowels become distended by accumulations in them, and wear a suitable bandage.

Sterility.

The chief purpose of marriage, both as a civil and religious institution, is the continuance of the race. When, too, this design fails of accomplishment, husband and wife do not attain that perfect development of character belonging to complete manhood and womanhood. Not merely in the affections which children evoke from parents, but even in the industry, the cares and sacrifices required in their behalf from those parents, will be powerful elements of moral culture and stimulus to the pursuit of virtue, and also strong home-ties, and one of the best securities of social order. A childless home is often a sad home, and the husband and wife who have no offspring to care for them in sickness, to close their eyes in death, to inherit their name and labor, and cherish their memory, are generally worthy of all pity.

In the old Greek mythology, only Minerva was represented without breasts, and from the earliest history of the race we learn that barrenness was one of woman's severest reproaches. The subject of sterility, therefore, is one of great importance. By this term is meant incapacity for reproduction. When the first act in the series resulting in the production of a new being—this act being sexual intercourse—cannot be performed, the party laboring under such disability is said to be impotent. This impotence may belong to male or female, and, of course, sterility is, in either case, the necessary result.

Furthermore, the sexual act may be accomplished with great facility, and still impregnation not occur. Here again the fault or defect may belong to man or to woman. Popular belief is frequently in error in attributing a childless marriage to some disability on the part of the wife. It would be well in all cases where some obvious cause of this sterility cannot be readily ascertained as existing in the female, for the husband to undergo a careful examination by a physician.

One other matter deserves allusion in connection with the subject of sterility.

It sometimes happens that a newly-married couple, either because they think themselves too poor to have a family, or because they will not permit the pleasures and gayeties of social life to be interfered with, deliberately resolve they will have no children for the time being, and make use of means to prevent the legiti-

mate result of sexual intercourse. Or worse still, conception having occurred, still other means are resorted to for the procuring of abortion. This course is full of dangers, not less to the physical than to the moral nature, and those who even think of pursuing it ought to be earnestly warned. So too, it sometimes happens that by and by they weary of their childless home, and are anxious for offspring. Not always then can this desire be gratified. In consequence of the injury done in past times, impregnation fails, or pregnancy is not completed; there is then no place for repentance, though sought diligently with tears.

Further remarks will be limited to sterility in woman. As causes of female impotence may be mentioned: certain tumors or unnatural enlargements of one or more of the external organs of generation, adhesion from side to side of these organs, an imperforate hymen, preternatural smallness, or entire absence of the vagina.

None of these things, however, may prevent perfect sexual congress, and yet sterility may exist. Recurring to the subject of conception, it will be remembered that the ovule and spermatozoon, germ-cell, and sperm-cell, must meet together, must unite to form a new being. But if the ovaries be absent, or if there be certain diseases of them, there will be no ovule. So too, if the uterus be absent, or its mouth closed, of course the union referred to a moment ago cannot be effected. There may be obstruction or malformation, or displacement of the Fallopian tube or oviduct, likewise preventing this union. These causes, however, are among the rarest of sterility. Much oftener this results from some displacement of the womb, or contraction or distortion of its canal; or else a copious leucorrhœa, a uterine catarrh washes the spermatozoa away, or is so poisonous to them that they cease all movements, and perish in a few minutes after coming in contact with it.

The lining membrane of the womb may be so diseased that it cannot furnish a suitable nest for the impregnated ovum. From ulceration, or inflammation of the womb this organ may be in such an irritable condition, that while impregnation may occur, an early and unrecognized abortion renders the woman sterile.

It may be said in general that both women who are very fat, and also those who menstruate quite profusely, are not apt to conceive; or, having conceived, are especially liable to miscarry.

Treatment.—The more frequent causes of sterility on the part of the female are generally remediable. Bring those organs into a healthy condition and normal position, and the difficulty so far as she is concerned will be removed. The menorrhagia or the leucorrhœa must be cured, the displacement corrected, the contrac-

tion or the distortion of the canal of the uterus relieved, and the inflammation and ulceration appropriately treated. From what was said in a previous part of this contribution, it will be borne in mind that intercourse occurring just prior to menstruation, or within a few days after, is more likely to be fruitful than at other times. So too, a caution may be given as to too frequent indulgence. Such indulgence enfeebles the male, and tends to induce on the part of the organs of the female, especially the uterus and ovaries, an irritable, exhausted condition quite unfavorable to the proper propagation of the species. One of the most distinguished of British surgeons, the late Mr. Acton, laid down as a rule, that once in a week or ten days is as often as strong, healthy men should indulge.

The invigoration of mountain air, or of sea-bathing will sometimes be beneficial to a woman in whom debility seems to be one of the causes of the sterility ; indeed, any absence from home in pleasant visiting, especially by securing entire rest for her sexual organs, will be beneficial. So too, the administration of iron for six or eight weeks at least, is sometimes of great benefit in such cases.

NOTE.—Hemorrhoids or piles may occur in pregnancy when there is neither diarrhœa nor constipation, simply pressure of the enlarged uterus on the blood-vessels, interfering with the return of blood, being the cause. Under such circumstances small doses of Fowler's solution (solution of arseniate of potassium) and tincture of nux vomica—say three drops of each, taken in water thrice daily—will be sufficient.

In hemorrhoids occurring after labor a teaspoonful of the flowers of sulphur, taken in a teaspoonful of syrup, will be the best thing to loosen the bowels.

Three grains of thymol in three ounces of Cologne-water, to be sprinkled from time to time on the napkins of a lying-in woman, will be most useful in removing the unpleasant odor of the discharge which takes place after labor.

THEOPHILUS PARVIN, M.D.

The Care of Infants in Health.

BY

BEVERLEY ROBINSON, A.M., M.D. (Paris),

OF NEW YORK CITY,

PHYSICIAN TO THE CHARITY AND ST. LUKE'S HOSPITALS; SURGEON TO THE DEPARTMENT FOR THE THROAT IN THE MANHATTAN EYE AND EAR HOSPITAL; LECTURER UPON CLINICAL MEDICINE IN BELLEVUE HOSPITAL MEDICAL COLLEGE, ETC., ETC.

THE CARE OF INFANTS IN HEALTH.

THERE should be few topics of greater interest and importance to a mother than what relates to the tender, but, at the same time, proper and judicious nursing, feeding and general management of her infant. I regret to say, however, that this matter is much ignored by those who should be best acquainted with it. Many reasons may be assigned for this unwelcome fact. First, it may be said that people do not appreciate its importance, or they believe there is little to be learned, and that what they already know is quite sufficient. Again, this ignorance may be explained by lukewarmness or neglect. For, surely, no one will affirm that opportunities are not afforded to a careful and dutiful mother to acquire the necessary knowledge. Many excellent books have been written on this subject, both popular and scientific ; and if they were read with care and their instructions applied under suitable circumstances, we should doubtless encounter fewer ailments of infancy. and ruddier and more vigorous offspring.

General Hygiene of Infants.

Clothing.—An infant's dress should be soft, warm, and sufficiently loose to permit free movements of the limbs. Any method of dress which prevents, in a certain measure, the easy performance of all natural functions is, by so much, imperfect and injurious ; yet how frequently do we see an infant's dress so tight around the waist that the functions of breathing, digestion, and circulation are all tramelled. Moreover, the danger thus occasioned of protrusion of the bowel in some region, or of collapse of portions of lung, is by no means slight, as the experience of every physician affirms. Safety-pins are the only ones which should ever be employed in attaching a baby's clothes. Other pins are far too dangerous to be used, as a rule, by nurses. The old habit

of hardening infants by means of insufficient clothing is fortunately fast disappearing. Still I do not consider it out of place to affirm here that bare necks, arms and legs, ought never to be seen.

In France the clothing of an infant consists of a night-gown of cotton next the skin ; over this a flannel undershirt, and over this again a chemisette of fine linen, open and fastened at the back. Then there are the swaddling-clothes, consisting, as it were, of a series of small sheets : one of linen, a second of wool and a third of cotton. These go completely around the feet and lower limbs of the infant, reach upward as far as the arm-pits, leaving the arms free, and are attached firmly behind by means of safety pins. American and English people clothe their infants with a number of long dresses of different material, and the consecrated diaper is still in vogue. Each method has its advantages : the French in that the child is kept warm and its legs straightened out as they should be, if proper attention be paid to perfection of form ; that of the English is preferable in that it allows the infant to move its legs freely and so promotes its muscular activity and general nutrition. With both fashions of dress for infants there is about the same amount of inconvenience attendant upon the change of soiled lower garments.

It is always a hazardous experiment, even in very mild weather, to allow infants to go about the house partially uncovered. In wintry weather, such as we have in our northern climate, it is the veriest foolhardiness. Why is it, may I ask, that just so soon as years of reason are reached this custom is abandoned, and, while a child is unable to express its feelings of discomfort, it is, at times, persisted in ? There can be no reason except that people are unreflecting, and occasionally follow fashion to the detriment of their children's health. I am fully persuaded that one-half the attacks of cold with hoarseness, and of spasmodic croup, which so often alarm fond mothers, is due solely to a bad hygiene, and particularly to exposure to cold without proper covering.

During the late autumn, the winter and early spring months, infants should wear a woollen under-garment over the chest and abdomen. During the first weeks a thin cambric jacket should cover the chest next the skin, and over this a wide flannel band reaching from near the arm-pits to the hips. In cold weather and for children from six weeks to one year of age, a knit jacket should be worn in direct contact with the chest, and the flannel band over this, as previously over the cambric. After a child is one year old, it should wear a merino shirt of suitable thickness, with long

sleeves and high in the neck. The flannel band is to be worn around the abdomen during the first six months, and should not be taken off entirely in very warm weather; but its thickness may be diminished, and it ought to pass but once around the body at this season. After the flannel band is given up, the flannel petticoat worn by most infants is all that is required, in this way, over the lower portion of the trunk and the inferior extremities. Even in very warm weather an undershirt of material which easily absorbs perspiration and yet is not cold to the skin (as linen, muslin, and cambric become when wet with moisture) must continue to be worn. To do otherwise than this is not to promote bodily vigor, but to combat it effectually. Of course the degree of heaviness or lightness of the woollen, merino, or gauze undershirt must vary with the temperature, and it must ever be appreciated that any clothing, or material next the skin, which keeps the child constantly wet with perspiration—in other words, *too warm*—is just as bad, if not worse, than to give an infant insufficient clothing.

When infants are but a few months old their legs are sufficiently protected by the ordinary flannel petticoat and the skirts of different material which compose their dress. When they put on short dresses it is proper to give them stockings reaching above the knees. Worsted knit socks are sufficient until the baby puts on short dresses, when thin leather shoes, amply large, should be worn until such time as the child is old enough to walk in the street. At that period really thick-soled shoes should be worn, and the feet are thus kept warm and dry. Colds may be rendered less frequent in young children by having some slight protection over their ears whenever they go into the open air during the winter months. One other point is worthy of consideration, viz.: cold is taken just as easily by the rapid passage from a very cold or damp atmosphere to one where the temperature is excessively dry or elevated, as by the sudden change from the latter conditions to those first mentioned. We should be careful, therefore, to counsel nurses:

1. Not to keep the nursery at too high a temperature, and always to have a basin, pitcher, or bucketful of fresh, pure water, with the surface exposed to the air contained in the room.
2. Not to allow children to approach a fireplace or register immediately upon entering or leaving the house.
3. Not to keep extra wraps on their little charges, when at home, a moment longer than is absolutely essential.

The temperature of the nursery until an infant is nine months to one year old, should be 68° Fahr. during the day. During the night the temperature may be permitted to fall to 65°–62° Fahr.

When a vigorous child is able to run about, 66° Fahr. is a suitable temperature during the day. The head of an infant should remain uncovered when it is in the house, unless it be carried from one room to another during the night; at these times some light woollen material should be thrown over its head and around its body. Nursing infants often take cold in being transported to their mothers at night without this precaution has been taken. Even in the open air the head-covering should never be too warm, as it makes the child subject to colds in the head. The habit of surrounding infants' necks with mufflers of any description is always hurtful, and makes them liable to have sore throat or croup from slight exposure to changes of temperature. After attending to the above rules in regard to the clothing of small children, one may safely permit fashion to dictate at will.

Baths.—In regard to baths opinions differ. Some persons believe they should be given daily to an infant, others think that twice a week is often enough. I can see no reason for not washing a child in a tub every morning. Of course it should stay in the bath but a few moments—in fact, only the time necessary to cleanse it thoroughly. At first the head and neck should be washed and occasionally soaped; then the arms, trunk, and lower extremities. The mouth should also be washed with a little clean water. During the first day or two the temperature of the bath must be about blood-heat (98° Fahr.); after that it may be lowered gradually, and when a child is twelve to eighteen months old it ought to have a bath of a few moments' duration each morning, and of a temperature ranging between 60° and 70° Fahr. At a later period still, say two to three years, the daily baths may be even some degrees colder. Bathing in water of low temperature is, in my estimation, the best preventive against the recurrence of colds. It renders active the functions of the skin, makes the child healthful and vigorous, and thus lessens the likelihood of localized congestion of mucous membranes.

Mothers, nurses, and even some of my professional brethren, are too much disposed to underrate the value, or be fearful of cold bathing. They recognize how useful this is whenever adults are concerned, but they do not believe this to be true of children, or, if they acknowledge that cold baths might prove beneficial, they dread to transform their knowledge into practice. They seem to consider that a small child is not sufficiently strong; that its vital forces are not energetic enough to be able to resist such a heroic method of treatment. They tremble for the safety of their nurslings or children of a more advanced age, and cannot bear to carry out this rational therapeutic system And yet is it not mani-

fest in our ever-varying climate, that, in spite of every precaution being exercised which is dictated by maternal solicitude, children must, of necessity, be more or less frequently exposed to all the evils that result from draughts, or from cold, or excessive humidity in the atmosphere?

Our object, then, should be to protect them efficiently from the adverse effects of our own trying climate. Now, *hot*, or even *tepid* bathing, is, I believe, one of the main causes of recurring congestion of the throat and bronchial tubes. And I may ask, can it be otherwise? Take a child of relatively feeble and lymphatic constitution, and subject it to bad hygienic influences, viz.: surround it with an insufficient or vitiated supply of air, give it improper food, or cover it with badly adapted clothing, and will you not find that it gradually becomes more markedly strumous and sickly? Warm bathing is to be ranked in the same category. It is enervating, and takes away from bodily vigor. The skin, it is true, is actively congested during the period of the bath, and its capillary circulation is greatly augmented; but just so soon as cold air strikes upon its surface, either directly or through the habitual wearing apparel, the blood-supply is driven with increased force (owing to the rapid contraction of the small vessels of the skin) toward the internal organs and mucous linings, which, in their turn, become congested and remain so more or less *constantly*, unless by a superabundance of clothing the baby is kept in an unnatural state of heat.

If the temperature of the water used in bathing is as low, or lower than that of the surrounding atmosphere, what a different physiological condition takes place! A temporary shock follows immersion or the use of the sponge filled with water, after which there is a short period when the surface temperature of the body is lowered, and then a natural warmth or glow takes place, the skin is reddened, its capillary circulation is heightened, and not merely in a temporary manner, but shortly becomes so permanently, the interior organs are relieved of an overload of blood, and their several functions are rendered more active.

In the event of the natural warmth (which almost invariably follows the rapid use of cold water for bathing purposes) not manifesting itself, we ought to have recourse to *friction*; and rubbing, gently at first, and soon with a firmer pressure, the entire trunk and limbs, will greatly stimulate the action of the skin. The rubbing should always proceed from the extremities toward the heart, or in the direction of the venous blood-flow. The use of some fatty or oily substance, of bland, unirritating nature, is an excellent aid in carrying out the above treatment, and is especi-

ally of service where the skin is dry, has a slightly scaly appearance, and so gives evidence of imperfect nutrition or lack of healthy power.

In the bath soap should be used moderately and when required. I do not believe it is necessary to soap any portion of the body every day. The proper selection of this article is of importance.*

A baby's head should always be washed each day, and thus kept perfectly clean. If there be any formation of "yellow crust" on the scalp, it must not be allowed to remain. By greasing the parts so covered, at bed-time, and washing them the following morning, they may be thoroughly cleansed in a few days. The use of a soft hair-brush is also frequently advisable. There is no *possible* danger to the child's health from the removal of these crusts in the way described. If allowed to remain, as some ignorant people consider to be best, they cause discomfort, constant itching, and lead, occasionally, through scratching by the infant, to the formation of matter (pus).

Immediately after a child is taken from its bath, it should be quickly and thoroughly dried and powdered in all those regions where the skin is soft and lies in folds. Redness and rawness are thus effectually prevented.

Of course, the above rules in regard to bathing must be somewhat modified in accordance with the natural vigor of the child. If the infant is weak and feeble, I would *not* counsel baths of such low temperature as is described, for the shock upon entering the bath might possibly be too great, and the reaction of the body-surface upon leaving it might only be established with great difficulty, or not at all. In this matter, as in many others pertaining to individual hygiene, a certain latitude should remain with the intelligent mother or nurse, and she should endeavor to adapt, so far as may be, certain well-established general principles of conduct to varying conditions of body.

Sleep.—When a healthy infant is first born, and during some weeks afterward, it sleeps nearly the whole time, except when it is nursing. Little by little it sleeps less, and when several months old, it takes a morning and afternoon nap and sleeps throughout the night, waking twice or three times to nurse or be changed. If, from the time of birth, a baby receive from its nurse *good* habits in regard to sleep, it will usually make all the difference between relative comfort and ease to the nurse, or absolute discomfort and unceasing annoyance night and day.

An infant ought to be put in its cradle and allowed to fall asleep

---

* See further on this subject in the chapter on the Skin and Hair.

in the very beginning of its existence, without being rocked on the knees or in the cradle, or sung to, or patted, or carried about the room in the nurse's arms. It is an easy matter to give an infant proper habits at first, but if they be ignored and neglected during a few days, it will then be most difficult to change those which are acquired. When a baby is put into its cradle at first, it will sometimes cry for a while and then fall asleep. If, however, the nurse is sure that the baby is not suffering and is in need of nothing, she has but to resist her desire to take it from its cradle and lull it to sleep again, and, after very few repetitions of this same course, there will be no further trouble about the infant's sleep.

Regularity in the hours of sleep as the child increases in age is important. The daily nap should be at a time when it does not interfere with the child's promenade. This is especially to be attended to during the winter months when the child can go out, even in good weather, only between a very limited number of hours. When an infant is one year old, it should sleep from six o'clock in the afternoon till the next morning without waking more than once or twice. Attention should be directed to the covering and surroundings. Do not heap up the bed-clothes and oppress the infant by too great a weight of coverlets. If this be done the child is apt to perspire profusely, lose its strength, and catch cold so soon as it is taken out of its cradle.

Another bad custom is to surround the baby's head, during the first few months, with closely drawn bed-curtains, so as to shield it from draughts of cold air, and to draw up the bed-clothes over its mouth, so that the real wonder is how it gets any air to breathe at all. There is no reason in this custom. In a large and properly ventilated room, an infant may and should breathe in the air freely and without stint, and the fear of draughts under these circumstances is merely imaginary. A curtain or screen, however, which prevents too intense light from falling directly upon the eyes of a newly-born infant, is useful and will prevent the occurrence of many cases of inflammation of the eyelids. Generally speaking, the cradle may be placed in such a position in the room that no curtain or screen around the head of the bed is found to be necessary.

The air of the room in which the infant sleeps should be as pure as possible, and it is particularly injurious to an infant to sleep in public halls or churches, where a large number of people are congregated.

The sides of the infant's cradle should be protected by wadding, so as to prevent it from hurting itself, and also to avoid the cold contact of the iron bars of the cradle with the child's body.

An infant's rest may be broken from many causes. The pressure of a tooth against the inflamed gums in teething, a worm in the intestinal canal, a too late or imperfectly digested meal, etc., may all disturb its rest, so that the nurse's patience and health may both, at times, be nearly exhausted. The cause of disturbed sleep should be immediately investigated, and remedied so soon as possible.

It is not wise to take the habit of walking on tip-toe and speaking in a whisper in a room where an infant is asleep. Children can be habituated perfectly well to sleep with noises in their vicinity, and the habit of waking upon the slightest provocation, owing to walking or talking in the room where they are, is frequently a source of much inconvenience to those who have charge of them.

An infant ought never to sleep in the bed with its mother or nurse. It is dangerous, as the person may lie upon it and produce suffocation; it also prevents sleep from being so refreshing as might be to the child, and to the mother or nurse. If an infant suffers from cold, wrap up a bottle containing hot water in flannel, and place it in the cradle near the infant; but never heat bricks or irons at the fire and then put them in the cradle, as they may set the clothes on fire and seriously burn the child. While it is an excellent thing for a newly-born child to sleep a great deal, it should not be permitted to lie in its cradle the whole day. It should be taken up occasionally and walked about. In this way it will get strength and health, but otherwise it will become rapidly enfeebled. [It is necessary to observe this precaution in the case of feeble children, since the circulation of blood is in such instance often so feeble, that when the infant is allowed to lie long in one position the blood accumulates in the lowest parts of the body, and serious results may follow the congestion thus caused.—Ed.]

A child, so soon as it wets or soils its diaper, should be taken up, washed carefully with a sponge and tepid water, thoroughly dried and powdered and then changed, and either put into its cradle again, or, if it has slept long enough, should be promenaded in the bedroom, or around the house, according to its age. If it be summer and the temperature is pleasant, it is healthful for the infant to sleep in the open air, especially in the country and where there are fine trees near by, as they give ozone to the atmosphere. Whenever there is much moisture in the atmosphere, it should never be allowed to sleep out of doors, and should never remain out late in the afternoon or after the sun has gone down.

Without the advice of a physician, no mother or nurse should, on any pretext, administer quieting draughts or potions to make

a child sleep. Sleep is a function too important and too delicate in its relations to health, to be meddled with injudiciously and ignorantly.

Exposure to the Air and Promenades.—Under this head I shall include all I have to say in regard to a child's exposure to the atmosphere. Fresh, pure air is essential to an infant's perfect well-being. It is fair to infer, therefore, other things being equal, that it is better off in the country than in the city. Without doubt this conclusion is true, and almost absolutely so during the summer months. Inasmuch, however, as it is impossible to always have those conditions which are best, the nearest approximation is what we should most earnestly seek after. During the warm months an infant may commence to go into the open air when it is two weeks old; when the weather is cold, it ought to be at least one month old before going out. In rainy, boisterous, or very damp weather, a very young child had best remain in the house. A child should go out every fine day when once it has begun to enjoy the open air. At first it may remain out of doors an hour; afterward, for several hours each day, and in summer time it should be in the open air for a great portion of the day. In winter it should not go out before ten o'clock in the morning nor after four in the afternoon. At this season it ought to be taken out twice and not kept out too long at one time or else it will become chilled. From one-half to one hour each time, when the weather is very cold, is long enough. During the summer months the baby ought to be out all the forenoon—from half past six o'clock to ten or eleven—and again in the afternoon from three o'clock till near sun-down. In the middle of the day it had best remain in the house, unless there be some shady, cool square, garden or park to which it can be taken, in which case it may remain out of doors nearly the whole day. In the country and in a large, airy house, it is less important for a child to live a great deal in the open air than it is in the city. Still it is an error ever to believe that the air of the house can be equally invigorating with that of the air out of doors.

Sunlight is very useful to children excepting when the heat is too intense and while the child is yet but a few months old. Before that time the eyes should be carefully shaded from its rays, and even afterward, in the summer months, it is unsafe for the child's head or eyes to be exposed to its rays with a hat as the sole protection against its action. A parasol of thick material should then effectually shield its head.

When an infant is taken out for a promenade during the first few months of its life, it ought to be carried in the nurse's arms, and ought not to be put in a perambulator or baby-carriage. If

there is much air blowing, a light veil should be worn over the face. When carried it receives heat from the nurse's body, and, its covering being about the same in thickness, it is thus kept much warmer. Its hands, feet and face should be watched, and if they get cold, as they will occasionally become in winter, the child should be brought into the house. Usually a child will begin to be restless and cry out when it is uncomfortable or suffering, and if this be remarked it should make the nurse more attentive and desirous to find out if her nursling suffers from cold or other cause.

When a child is six months old, or even before this time if it be a strong child, it may be promenaded in a perambulator or suitable carriage. It is then able to sit up and notice, in a measure, what takes place in its vicinity. Before this age the child simply lies flat in its carriage, and is apt to remain unobserved by its nurse, and may, in sleep, hurt its head or neck, or take a wrong position. Of course this may also occur with an older baby but is not quite so probable. Moreover, the older the infant is the more it generates heat, and the less likely it is to catch cold in its carriage.

An infant ought not to be carried always by the nurse on the same arm. Its position should be varied occasionally from one arm to the other of the nurse, and in this way all danger of acquiring deformity through unnatural and long-continued similar postures, is avoided. When an infant reaches one year to eighteen months of age, it usually commences to walk. At first its efforts are feeble, and it is only able to sustain itself for a few moments by resting its hands upon some piece of furniture and, while sustaining itself thereby, pushing before it in the room a chair or table of suitable height. Babies ought never to be urged to walk. Nothing is more foolish and nothing, at times, leads to more regretable consequences. A child is sometimes, owing to the solicitations of its nurse, put on its feet and made to stand and step out when its legs are not strong enough to carry the weight of its body. It is thus many children become bandy-legged, knock-kneed and subject to other deformities of the lower limbs. Where a child is already "rickety," and its bones are even more wanting in consistence, future deformity is almost certain if a vain and senseless habit is persisted in. Every child will walk when it ought to, and without aid or help from any one. Let it make its own efforts, almost unaided, except when it is in imminent risk of hurting itself, and everything will turn out for the best.

All those precautions and anxieties which are taken or felt by mothers and nurses, lest a baby should fall and hurt itself, are

worse than useless. A child soon learns to take care of itself in a great measure, or, at all events, when it gets an unlooked-for fall, to take the fall without bodily injury of serious nature. Their little elastic bodies do not get hurt if you let them alone, and their heads also escape injury in the great majority of falls.

Of course I would not for a moment urge, or even countenance any want of rational care on the part of the nurse. It would, in my estimation, be great negligence, and even criminal, not to have bars before the windows, a wire screen and fender before the fire, gates before the doors and at the top of the staircases, and all articles removed from the nursery with which a child may do itself any possible injury. But this does not mean to run and take hold of a child whenever it frisks and jumps or loses its equilibrium momentarily, nor does it imply that it is right to utter a sudden cry or shriek when a baby has a tumble and has scarcely hurt itself. The proper way to do under these circumstances is to let the infant alone, or, if the nurse will insist upon running to pick it up, she should do so laughingly and as if the matter were only one for a joke. Children are very imitative and if they see their nurses or mothers take trouble or interest, they will do so too, and then for a very slight pretext they will cry loudly and for a long while, and an ignorant nurse will believe they really are hurt, when nothing serious is the matter with them. If, on the contrary, a fall is laughed at, the child will after the first moment also laugh.

A child, when it commences to walk in the street, at an age of two and a half to three years, should not be urged to walk long distances without stopping or changing its gait. Such exercise is not beneficial for very young children. It is much better to encourage it to exercise by frisking and playing about, with short intervals of rest. In this way, too, its childish mirth and joyfulness and its intelligence and health are, at the same time, most promoted.

When a child is forced to remain in town in hot weather, its health may be maintained by frequent daily excursions to the country. By boat is best ; by the cars is better than not at all. It should go out in the early morning and return to the town only a little before its sleeping hour. In this way the mid-day heat in the city is absolutely avoided.

If, however, an infant, especially in its second summer, has an attack of persistent vomiting or diarrhœa, or both, it is very wrong to keep it in the city if it can possibly go to the country. Among the poorer classes the large proportion of children thus affected will die ; among people in easy circumstances, and in spite of much care, the termination will also be fatal, unless coun-

try or sea-air is promptly given to the child. All that drugs or diet can do will not compensate for the lack of a pure, cool, bracing atmosphere. The air by the sea-shore is generally most beneficial and will sometimes effect cures so rapidly, and by itself, that they would appear almost miraculous did we not know by numerous examples that such happy results may be anticipated.

Action of the Bowel and Bladder.—During the first three or four days after birth, attention should be particularly directed to the excretion of urine and the discharge of meconium. This latter is the substance which accumulates in the bowel of the infant previous to its birth, and is expelled usually within twenty-four to thirty-six hours from the period of delivery. It is of greenish, or deep black color, and very viscid, and is formed of the mucous secretions of the intestine mixed with bile. The expulsion of the meconium may occasionally be retarded. When this is the case, and we are sure the infant is properly formed, a warm bath should be given.

The use of some mild laxative is also advisable, such as a few tablespoonfuls of whey, a teaspoonful of oil of sweet almonds, syrup of violets or syrup of rhubarb, or sixty grains of manna. Some mothers believe one or other of these substances should be given to all children, and advise not to wait for the natural discharge from the bowel. This is a mistake, for, if the infant be suckled by its mother, nature supplies a purgative in the colostrum, or first milk, which is usually sufficiently active to clear the bowel of its contents. When, however, the infant is nursed by a wet-nurse whose milk is already a few weeks or months old, or when it is brought up by hand from its birth, it is judicious, and sometimes essential, to make use of one of the simple remedies mentioned above. It is well, also, to be aware that the tepid sugar and water, so frequently given by midwives to infants during the first day, is ordinarily all that is needed.

Some days after the birth of an infant, the mother or nurse is occasionally made anxious because it has not passed water. This anxiety is frequently without cause. The urine is often voided while the infant is bathing, and escapes notice. If, however, it be retained longer than usual (twenty-four to thirty-six hours), the application to the belly of a cloth wet with cold water, or a teaspoonful of cold water given by the mouth, will generally have the effect of remedying the trouble. If a malformation of the anus, or urethra, be found, a physician's advice must, of course, be immediately sought.*

---

* See, also, chapter on Affections of the Anus and Rectum.

Period of Milk-Feeding.

During this time it is best for all infants that they should receive breast-milk. At times this is, for different reasons, impossible, and then the infant has to be brought up with cow's milk taken from a bottle, spoon, or cup. When a mother is to be capable of nursing, usually toward the end of pregnancy the first milk, or *colostrum*, is secreted by the breasts. This colostrum is a liquid frequently of yellowish color, and somewhat viscid. It differs from milk in that it contains a number of "granular bodies" smaller than real milk-globules, and has a slightly purgative action when taken internally.

The qualities of the colostrum have an evident relation to the qualities of the future milk. If it be scanty, the milk will be small in quantity; if it be abundant but watery, the milk will have like properties; if it be thick, white, and also abundant, the mother will have an ample supply of good milk. Until the slight fever which comes on the third or fourth day after delivery has passed away, the liquid of the breasts has the qualities of colostrum. Gradually, however, the granular bodies disappear, and after the fifteenth day from time of delivery there are no more of them. Of course these bodies can only be detected by the use of a microscope, and never by the unaided eye.

When the colostrum has become real milk, the following are the characters of this liquid: it is white, opaque, alkaline, and of agreeable taste. Like the blood, it separates into two parts, by repose—an upper layer or "cream," which contains most of the globules of milk, and a lower layer (by far the larger portion), which is more fluid, and is composed of water holding in solution casein (or cheese), salts, and sugar of milk. The number of "globules" varies according to the richness of milk, and the richness varies with different women and with the same woman under different circumstances of health.

The *duration* of milk-flow is somewhat variable, but usually lasts from twelve to eighteen months. The *quantity* of milk secreted is even more variable than the time during which the secretion lasts. This does not depend altogether upon the health of the mother, for many delicate, feeble women have a large supply, while some robust women have a wholly inadequate amount. If the mother be either too old or too young, her milk may be insufficient in quantity. Usually, the abundance of breast-milk increases in proportion with the number of children a woman has had.

It is a questionable matter whether the quantity of milk can be much influenced by the nature of the food taken by the mother.

Still it is a favorite idea with some persons that the milk is notably increased in amount by certain kinds of food; and as the oatmeal gruel, milk, porter, ale, etc., taken with this intent, are all nutritious articles of diet, the habit may be moderately indulged, although it should be understood that the best food for a mother, in any particular instance, must depend partly upon the state of her health and partly upon her previous habits.

Many circumstances modify the *quality* of breast-milk, such as the health of the mother or nurse, emotional feelings, the condition of the genital functions, and the regimen followed.

In sickness the solid elements of the milk are increased, while the proportion of water diminishes. In consequence of this change, the milk frequently disagrees with the infant, and causes pain and indigestion. If sickness of the mother occurs shortly after the period of delivery, the milk secretion is at once diminished in quantity, so that the infant suffers, also, from lack of sufficient nourishment. If the breasts become engorged, and an abscess forms, there is additional risk to the infant, from the fact that matter (pus) may become mixed with the milk, and, if swallowed, could not fail to be injurious.

Fear, anger, grief, all tend to lessen the quantity, and to alter the quality of breast-milk. The rule is therefore obligatory upon a nursing mother to shun carefully all unnecessary or pernicious kinds of excitement. Her life should be placid and calm, and wholly removed from all excessive feelings; for, if passion of any kind be permitted, her infant will immediately feel the bad effects of it.

Although the menses are not usually present during the period of nursing, they sometimes are. Their influence has been thought to be injurious to the infant, and while this is often the case, it is not true always. Of course, if the nurse suffers from an abundant and weakening menstrual discharge, and the amount of milk is notably diminished during this time, the probability is that the infant will suffer considerably in its nutrition, and it is preferable to abandon nursing. When a child loses very little or no flesh during the menstrual period of its mother, I cannot find sufficient reasons for advising her to give up her charge to another. If, on the contrary, there be little doubt that the nurse has again become pregnant, I should not hesitate to advise an immediate change.

The quality of the milk is doubtless greatly influenced by certain foods and medicines. The odor, taste, and even color of many substances can be communicated to the milk. I will only mention, in this connection, such substances as saffron, garlic, rhubarb, iodide of potash, and mercury.

Maternal Nursing.

There can be no question that the nourishment best suited to an infant is the breast-milk of its own mother. She should therefore nurse her offspring in all cases, except where there is some decided reason for a contrary course, such as will arise in the event of ill-health, or the existence of syphilis or tubercle in the mother. It is unwise for a mother to attempt nursing her child against the advice of her physician. Whenever she does so, all may go well during a month, or six weeks, after which time she may be compelled to abandon the undertaking, on account of diminution in the quantity of her milk. The consequence is that the health of both mother and infant suffers. In the event of a mother having the wish to nurse her own infant, certain precautions should be taken, in order that drawbacks, if they exist, may be avoided or overcome. The majority of these precautions have reference to the form of the nipple. Sometimes its form requires the employment of means which shall render nursing possible. More rarely it is a positive obstacle to the exercise of the function. The nipples may be somewhat shorter than is best, or they may even be depressed below the level of the surrounding skin. In this latter case they frequently become the seat of cracks in cold weather, even before nursing is begun ; and usually all means employed are inefficacious to enlarge them. When the nipples are merely less prominent than is desirable, by a judicious application of breast shields and suction they are more or less easily lengthened.

If much sensibility of the skin covering the nipple exists, this may be effectually treated by means which make it harder and less apt to become sore. These are alcohol and solutions of different metallic salts. [See also page 425.]

After delivery, and when the mother has already nursed her infant a few days or weeks, the nipples may become painful from fissures or ulcerations, which are the consequence of repeated suction or exposure to cold. Women are more subject to them with their first children. This is also true of women with badly-formed nipples, and whose skin is delicate.

Rules for Rearing Infants at the Breast.

During the first few days after delivery the colostrum is the natural food of the infant, and both the child and the mother become accustomed to their new functions. In order that the mother may have time to repose herself, it is preferable not to let the infant take

the breast during seven to eight hours after birth. One hour after the child is born a teaspoonful of warm sugar and water should be given to it, and be repeated every hour or so, until the mother is prepared to take it to her. If, for any reason, a mother is unable for several days to nurse her infant, milk, in the proportion of one-fourth, must be added to the sugar and water. Previous to nursing, the nipple of the mother should be moistened with a little milk or water, so as to render it more supple, and to facilitate suction. During the first few days, even a vigorous infant will find some difficulty in taking hold of the breast, and it is proper, therefore, to help it by guiding the nipple towards its mouth. A mother must nurse her child during the first few weeks every two or three hours, and must not consider her own feelings in this regard. Even though asleep, she must be awakened if her infant needs her. Unnecessary fatigue on the part of the mother during nursing may be avoided by placing the infant by her side while she is lying down, and allowing the nipple to fall into its mouth. In the beginning, of course, it is not to be expected that the infant will nurse long or take much. It tires easily, and frequently falls asleep while at the breast. It should always be watched, therefore, to see whether or no it actually swallows any milk. By observing the rise and fall of the "Adam's apple" during an effort of swallowing, it is alone possible to determine this fact. The regular application of the infant to its mother is the natural preventive of painful distention of her breasts, and for this reason, too, it should be carefully attended to. An infant may be permitted at each nursing to take as much milk as it chooses, and if too much is taken it will be thrown out of the stomach without detriment to its health.

Before giving the breast, however, the mother should endeavor to be assured that the infant is really in need of it. This need is not always expressed by the infant's crying. These cries must be added to other signs so as to signify that the child wants food. The time, moreover, of the last meal must always be considered ; for, otherwise, a mother is continually in danger of overloading her infant's stomach and giving it painful digestion. The mother must always give both her breasts alternately to the infant, and thus avoid the risk of either of them becoming too full. If the infant has difficulty in drawing the milk, the mother must press them gently so as to make it come out more easily. If the infant swallows too fast, owing to the abundant flow of milk, she must moderate its energy in this particular by slightly withdrawing the nipple from its mouth now and then. Sometimes heat, enjoyment, a full stomach, make a child fall asleep while nursing. If it has not

nursed enough it should be awakened; otherwise it should be placed in its crib.

The intervals of nursing must become less frequent as the child grows older, and especially at night. After the first month the infant should take the breast the last thing before its mother goes to sleep, say about 11 P.M., and it should not be brought to her again until 6 A.M. Meanwhile, if the infant wakes and cries, a little milk, water and sugar may be given to it from a nursing-bottle once, but not oftener. To act differently is to entail useless fatigue, anxiety and trouble upon the mother, and to give the child a bad habit which inevitably leads directly to attacks of colic and indigestion. Besides, if the mother for any reason is attacked with a temporary indisposition, it is wise to have so educated the infant as to render it independent of her at night.

Mixed Nursing.

This system of mixed nursing, in which a child is partly fed from the bottle, and only takes the breast three or four times in the twenty-four hours, is far preferable to an entirely artificial diet. If a mother loses her milk completely before her infant is six months old, she should then, without hesitation, endeavor to procure the services of a good wet-nurse. The same rule of conduct holds good in those instances where bad quality of the mother's milk causes sickness of the infant.

There are cases which appear to show that artificial feeding is equally good with the breast-milk of a wet-nurse—at least to the uninformed observer. I have seen a few very robust children of rich parents, brought up in the city upon the bottle almost from the time of birth, and such examples are not altogether infrequent in the country. Still, such exceptions must not be considered the rule, inasmuch as for one vigorous child thus reared there are an excessive number who die in the first month or year of existence, and those who remain suffer during childhood from different ailments, as a consequence of an enfeebled constitution.

If food be given to a child three or four months old while it is yet nursing, it should resemble, as nearly as possible, what nature provides for it, or its own mother's milk. No *bouillies,* panadas, soups, broths, or any sort of starchy food should be given it. Let it be thoroughly and absolutely understood that the child's nature at this age does not adapt it to this kind of nourishment. Physiology taught all physicians this fact in the most certain way possible, when the salivary glands were first examined and the quantity and properties of their secretions were fully determined.

All farinaceous substances, as such, are completely insoluble in the intestinal fluids. They have first to be changed into a kind of sugar by the action of the saliva before they are made capable of absorption. Now, in the first few months of worldly existence, the salivary glands are very small, secrete little or no saliva, and what there is of it has not the power of changing starchy food into sugar. To any one who will give attention to a simple scientific fact capable of the most exact demonstration, there cannot be the slightest doubt as to what their conduct should be with respect to giving or withholding food of this nature during the period of infancy mentioned.

At a later period (eight, ten or twelve months after delivery), well-cooked arrow-root, wheaten flour, dry biscuit, etc., may be given to an infant in small quantity, mixed with milk. At this age, soups of chicken, beef, and mutton may also be allowed. A soft-boiled egg occasionally for breakfast, a crust of bread, or a bone to suck, a small quantity of very light cocoa, may likewise be taken with advantage. At eight months of age the breast should be given four times during the day; later at two or three times only, and no nursing at night. The infant stops nursing gradually and is finally weaned. It does not suffer in health or disposition, and the mother's breasts suffer no injury from inflammation or formation of matter in them.

Weaning.

The period at which an infant should commence to take other nutriment than breast-milk will vary with its own condition and the health of the mother.

If the mother be robust and bear nursing well and her child thrives as it should, she may continue to give it nothing but her breast-milk during the first six or eight months. After this time it is proper, as a general rule, to let the infant have once and afterwards twice a day, a meal composed of milk and some light farinaceous food, of which barley, prepared wheat, and oatmeal gruel are the most nutritious. A child should be completely weaned when it is ten to twelve months old. Farinaceous substances given to a child before it is three months of age, is to be positively forbidden. Rarely, if ever, are they needed, and usually they are most injurious and cause unceasing trouble to parent and child.

The majority of children should be entirely weaned when they are one year old. In occasional instances, when the child is very delicate, or when dentition is difficult and very painful, it may be

prolonged a few months with advantage. It certainly solaces the child, and affections of the stomach and bowels may thus be avoided. The first teeth come out by groups, and between each one of these occasions there is a period of relative tranquillity, during which time the child is free from suffering for several weeks. If practicable, it is reasonable to take advantage of one such interval, to begin weaning the infant. The canine teeth should, in many cases, have appeared before the child is completely weaned. As a rule, it is preferable to wean a child by degrees. There are cases, however, when this system will not answer, and when mothers are compelled to wean their infants immediately. This can, of course, be better accomplished when the weather is cool, and when the infant is already habituated to other nourishment than breast-milk. If an infant is separated with great difficulty from the breast of its mother, it will rapidly become disgusted if the nipples be covered with a little extract of aloes or mustard, the taste of which are very unpleasant to it. The nurse can then take the infant and feed it.

An exception to the above rules occurs when the milk is insufficient in quality and quantity, and it has to be supplemented by the addition of some artificial food. This may be the case when the mother is in apparent good health and her supply of milk suddenly diminishes without obvious cause, or when the mother's health suffers through the continual drain upon her constitution, which also finishes by altering her milk.

The diet of a child, after premature or sudden weaning from any cause, is a subject which always earnestly reclaims the attention of its mother. It should be remembered that the infant's stomach has not been accustomed to artificial food, and very slight imprudences will derange its digestion and give it vomiting and diarrhœa. Under these circumstances, and during some weeks or months, the baby's diet should consist exclusively of cow's milk, with small quantities of light farinaceous food once or twice a day. In their unreasonable desire to make such children rapidly vigorous, mothers are too apt to give them food wholly unsuited to them, such as beef-juice, minced meat, potatoes, etc. There is no greater or more pernicious error, nor one against which we should more strongly object.

Regimen of Nursing Mothers.

All women who nurse should have a healthy regimen. Their diet must be varied, but bland, wholesome, and nutritious. Roast and boiled meat, such as mutton, beef or chicken ; vegetables of dif-

ferent kinds (always avoiding such indigestible or pernicious ones, however, as beans, cabbage, peas, and cauliflower) ; milk, chocolate, and all manner of farinaceous foods, and eggs in every style, are allowable and good. Spices, spirituous drinks, pastry, cheese, sweets of various kinds, should be strictly avoided. The meals should be frequent, but small in quantity, and easily digestible. A nursing woman should have plenty of sleep, and should be awakened as rarely as possible. She should breathe a pure air, have moderate physical exercise, and avoid cold, dampness, and rapid changes of temperature. Her breasts should always be properly protected with soft linen or light flannel, which should be changed as often as it becomes wet with the flow of milk. If they are very large and hang down, corsets must be worn as a support, otherwise they may become painful and inflamed. When the milk is so abundant as to flow from the other breast while one is being suckled, it is advisable to put the nipple into the neck of an empty vial, and so prevent the wetting of the mother's undergarments.

Baths are essential to cleanliness and good health. Many authors recommend them to be of short duration, and warm in temperature, and not too frequent. In my opinion daily baths are not injurious, and I favor decidedly the use of cold sponge-bathing, when such has been the habit prior to delivery, and when it is well borne. I know of one young mother who has frequently told me that nothing she can do so completely rids her of sensations of fatigue as her cold sponge-bath, which she takes each morning on rising.

A good preventive of chilliness during and after the bath, is not to have too much water in the tub. When standing in it, the water should not be more than one and a half inch deep, and should not pass above the ankles. It is sometimes advisable to have the water in which the mother stands several degrees more elevated than the temperature of the water with which she sponges herself. This may be readily effected by having a bucket of cold water alongside of the bath-tub. An energetic friction with a rough Turkish towel, or rather soft flesh-brush, before and after the bath, will stimulate wonderfully the capillary circulation, and make the skin red and warm. The bath should only last a few moments, and the bath-room itself should have a temperature about 68° Fahr.

If a mother can live in the country, it is certainly preferable to the city. The air is more revivifying, and contains oxygen in that ozonized or electrical state, which is without doubt most beneficial to the respiratory function, and also to the general nutrition.

The qualities of mother's milk are sometimes seriously affected

by the attack of an acute disease. If this be the case, nursing should be immediately stopped. If the disease of the mother be of a contagious nature, the poison may be inoculated to the child through the milk. Such affections are, notably, erysipelas and the eruptive fevers.

The supply of mother's milk may occasionally become either greatly increased or diminished. The latter condition may be suspected when the infant does not thrive, cries after it leaves the breast, and always seems unsatisfied and hungry. If the loss of milk is brought on by emotional disturbances, it may be hoped that it will return after the expiration of a few days. Meanwhile, the infant should be given the bottle. If it be due to other causes, it will frequently be persistent, and nursing must be abandoned.

Whenever the breast-milk becomes over-abundant, the mother's health is apt to suffer from an excessive drain on her system. This condition, as it is an evidence of weakness, may be remedied by a fortifying regimen and the use of tonics. If the general health of the mother, after she has been nursing some months, becomes rapidly poorer, nursing should be given up, lest she become consumptive. Whenever the breast-milk becomes either too poor or too rich, the infant suffers. By means of the lactoscope (see page 115) these two conditions can be determined. Artificial food, properly given, will remedy the consequences of mal-nutrition, while, by giving the infant only the *first* milk which comes from the breasts, and by an occasional dose of sugar and water after nursing, the vomiting and diarrhœa caused by too rich diet may be stopped.

Wet-nursing.

It frequently is necessary to secure the services of a hired wet-nurse on account of the disability of the mother. In the choice, great care and knowledge are to be employed, and it is always a delicate task. A complete examination of the person is not always possible, and, even though it were, so great are the difficulties and so many the deceptions used, that we can rarely have absolute guarantee for the non-existence of a constitutional taint.

A wet-nurse should have a pleasant, cheerful disposition, be fond of children, and of prepossessing appearance. Her moral character ought to be good, and her age between twenty and thirty years. Her last child should have been born at least two months before the nursling who is committed to her care, otherwise she is exposed to troubles which may follow delivery. The form and size of the breasts have only a moderate degree of importance, for

the quantity and quality of the milk are not always in direct relation with either of them. Nurses are seen with breasts of very good shape and size, who have but little milk, and there are others whose breasts are small and of poor shape, but who satisfy all the needs of the infant. When large veins are seen distributed over the breasts, and the nipples are well-formed and well filled with openings for the escape of milk, a good wet-nurse has usually been found. It is advisable that the wet-nurse should already have had one or more children : first, because she will have a more abundant supply of milk; second, she will know better how to take care of the child. The general health of a wet-nurse ought to be good, and there ought to be no syphilitic, tuberculous, or scrofulous tendency, inherited or acquired. Her milk should be rich, abundant, and flow easily. An examination of its quality should, when possible, be made with the lactoscope and microscope, in order to find out its relative richness in cream, and also to be sure that the milk-globules are of good size and character. The child of the wet-nurse should be examined to see whether he is in good health, and information should be taken in order to feel certain that no deception has been exercised in regard to the fact. It should be also known that it is brought up exclusively with her own breast-milk. Her infant should be watched while nursing to see that it swallows, and weighed before and afterward to see how much it has taken. This quantity ought to be from five to eight ounces. The milk ought not to be over six months of age, or it will be apt to disagree too soon with the newly-born infant. The wet-nurse must not give her breasts to the infant the first day of its birth. During this time a small quantity of tepid sugar and water must be given to it every two hours, and during three or four days afterward this mixture may be alternated with the nurse's breast-milk. After this time, the breast-milk alone may be given. During this period, also, if there be no positive objection to it, her own child may be kept close at hand so as to relieve her breasts of an over-accumulation of milk. Otherwise she must at first be very abstemious in her diet and not take a large quantity of fluids. The infant must never be allowed to sleep with its nurse, but must be placed in its own cot.

The regimen of a wet-nurse should be moderate in all things. Her diet may be varied, but her meals must be neither too abundant nor too frequent. Good, healthy food is what she needs, but no spices, no stimulants and no indigestible dishes or rich sauces. Certain vegetables, such as cauliflower and cabbage, are undoubtedly bad, and will occasion colic in the infant. No medicine should be taken by the nurse unless by the advice of a physician, as a child's bowels may in this way become deranged.

The wet-nurse should go into the open air each day and take moderate exercise. In bad weather, attention to household occupations is good for her, and she should not be permitted to idle away her time when not nursing the baby. If the nurse's health becomes bad, or if she shows a bad disposition, there should be no fear of changing her lest it may hurt the baby. Perhaps the child at first will not take the new nurse's breast, but by a little starving, and by giving the breast to it at night, a few days will ordinarily solve this difficulty.

Feeding with the Milk of Animals.

The milk of sheep, goats, asses, etc., is rarely given in this country. On the continent of Europe it is an habitual thing in the case of children who are in delicate health, or for those who have already been weaned, and when, by reason of ill-health, it is deemed advisable to medicate the milk through these animals.

Artificial Feeding.

By this term is meant feeding by cow's milk, from a bottle, cup, or spoon. Its signification, however, has been very much corrupted, and frequently this expression is understood to convey the idea of feeding an infant with all sorts of food other than milk.

While there cannot be a question as to the human milk being the true and natural food of the young nursling, still there are times when it cannot be supplied. If this be the case, does artificial feeding from a nursing-bottle, as it should be properly understood, merit all the opprobrium which has been heaped upon it? I do not believe that it does. Undoubtedly in large cities, and among the poorer classes, infants brought up by hand run terrible risks. In fact, the greater portion of them die before they have reached the age of one year. But, because, under certain conditions, this method of bringing up babies is so fatal, it is not essential that it should be so in all cases. In the pure air of the country, where there is an abundant supply of good milk, a healthy infant may be fed from its birth by hand, and grow up strong and vigorous. In the city, instances are also met with of this sort, but only when the mothers are very intelligent and careful women, and when they have given the strictest attention to the intervals, nature, quantity, and quality of their children's meals.

If a child is to be brought up by hand, it should be fed during the first five or six months exclusively with cow's milk. This

milk should be as fresh as possible, and from the same cow.* The cow should have calved within a somewhat brief period (two to three months), and should be *pastured* and not stall fed. The milk should have a small quantity of sugar added to it, viz., in the proportion of one teaspoonful to a good-sized teacupful. The sugar must be milk-sugar. The milk should also be diluted with water. During the first week the water should be in the proportion of three-fourths; after a month, one-half water ; three to six months, one-fourth water ; after six months, pure milk—the milk should be scalded, but not boiled. To boil it is to render it less digestible, and to render the infant costive. Boiling takes away the aroma, liberates the gases, and coagulates the solid particles of the milk. At first, the upper one-third of the milk taken from a pitcher or mug, which has been allowed to stand during several hours, is preferable, as it contains more butter and less cheese, and is therefore more digestible.

The intervals of feeding with milk from a bottle should be the same as those when the breast is given. It is always advisable to give the milk from a nursing-bottle, and not from a spoon or cup. Suction is made necessary in using the bottle, and this increases the flow of saliva and helps it to digest the milk. Many kinds of nursing-bottles have been vaunted. They all have advantages and drawbacks. The simplest is the best, as it is the most readily cleansed, and may be made in any household as follows : take an ordinary vial of a capacity of six ounces, cut a piece of sponge into the form of a nipple, introduce it into the mouth of the vial, and retain it there by means of thread passed through the sponge just above the mouth of the vial and tied around its sides. Both sponge and bottle should be kept soaked after each nursing, in clean water rendered slightly alkaline by carbonate of soda, one drachm to the pint.†

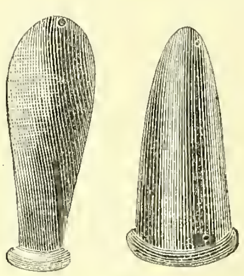


FIG. 215.—The best forms of india-rubber nipples for nursing-bottles.

* [This is true only when the food of the cow, and her surroundings are under control. If this control cannot be thoroughly exercised, it is thought to be better to use an average sample, taken from a mixture of the milk of several cows.

† [The most objectionable form of nursing-bottle is the one provided with a rubber tube and mouth-piece. It is almost impossible to keep the inside of this tube absolutely free from sour milk, and it is well kuown that a *very* small amount of sour and decaying milk wiil serve to spoil a large amount of fresh milk. If india-rubber nipples are used they should be of the form shown in the above figures. These can be attached to the neck of any bottle of suitable size, and after use can be turned wrong-side out and thor-

Nothing is more certainly pernicious to an infant's health than to take sour milk, and this in summer is a fruitful source of bowel complaints. Let the mother, therefore, test the infant's milk before each meal by means of a piece of litmus paper. If this paper turns in color from blue to red, she may know that the milk is sour, and she must either procure other and fresher milk for her baby, or else render what she has suitable for it by adding lime-water or soda to it (as above directed) until it becomes slightly alkaline, as may be noted by the use of the reactive paper.

Sometimes, when pure milk is too rich for a baby, instead of diluting it with ordinary water, decoctions of barley, bread, oats, rice, etc., are employed.* They serve a double purpose: they are nutritive and they help to hold in suspension the casein (or cheese) of the milk and to prevent it from forming large and firm curds in the stomach. If the infant vomits curds after nursing, or passes them in its motions, either the decoction of some vegetable grain, lime-water, or a little soda, should be mixed with the milk either during or after nursing.

After the age of six months a child may commence to take a small quantity of the ordinary starchy foods with milk. The best of these are barley, oatmeal, wheaten flour, and arrow-root. There is, in my opinion, an object to familiarizing the child's stomach with any of the foods known under a variety of names. All of them are based upon the same principle, viz.: to relieve the infant's digestion by partially or completely changing starch into dextrine. Thus there is little or no use for the secretion of the parotids and pancreas, and the infant is supposed to be benefited. Such is not the case, however, for either the child's stomach is unfitted for digesting farinaceous food by reason of its youth or ill-health, in which case it is far better without it, or it is capable of digesting these substances naturally, and in that case it should make use of its functional power, and not be aided and sustained at every stage as if it were a natural weakling.

To farinaceous substances, broths, occasionally an egg, a little minced steak or chop, a baked potato, a little custard or tapioca pudding, stewed fruits of different sorts, may be added with advan-

---

oughly cleaned, and afterward be placed in a cup of clean water until they are again required.

* [For this purpose a teaspoonful of prepared barley may be boiled with a cupful of water, so as to form a gruel. It may be mentioned, in this connection, that the cheese of cow's milk, when taken into the stomach of an infant, is apt to coagulate into large, firm masses, which are slowly digested, and cause irritation of the bowel by their presence, while the cheese of human milk forms soft, flocculent curds, as may be noticed in the milk thrown up at any time by a nursing infant.—Ed.]

tage, when it is a year old, or has had its "eye-teeth." Cakes, candies, pastry, cheese, salt meat, certain vegetables in their natural state (beans, peas, cauliflower, cabbage, etc.) are always injurious, and should not be permitted on any pretext. A good diet for a child from twelve to eighteen, or even twenty-four months old, is brown bread and milk in the morning, after its bath, varied occasionally with a saucer of wheat-grits, oatmeal porridge or hominy, all mixed plentifully with milk. At one o'clock a chop, or piece of tender steak, or chicken finely minced, with a baked potato and a little fresh butter, and milk to drink. At five and a half o'clock, brown bread and milk. To bed at six and a half to seven o'clock.*

The following are some excellent rules about babies, taken from Dr. Jacobi's work on Infant Diet:

"Boil a teaspoonful of powdered barley (grind it in a coffee-grinder) and a gill of water, with a little salt, for fifteen minutes; strain it, and mix it with half as much boiled (?) milk and a lump of white sugar. Give it lukewarm through a nursing-bottle. Keep bottle and mouth-piece in a bowl of water when not in use. Babies of five or six months, half barley-water, and half boiled (?) milk, with salt and white sugar. Older babies, more milk in proportion. When babies are very costive, use oatmeal instead of barley. Cook and strain. When your breast-milk is half enough, change off between breast-milk and food. In hot summer weather try the food with a small strip of blue litmus paper. If the blue paper turns red, either make a fresh mess, or add a small pinch of baking soda to the food. Infants of six months may have beef tea or beef soup once a day, or mixed with the other food. Babies of ten or twelve months may have a crust of bread and a piece of rare beef to suck. No child under two years ought to eat at your table. Give no candies ; in fact, nothing that is not contained in these rules, without a doctor's order."

It will be remarked that I previously objected to *boiling* the milk, save in diarrhœal complaints.

The Care of Feeble Infants.

When the infant is born feeble the same rules apply as in a healthy condition, with respect to dress, etc.—the subsequent care will be presently detailed. Occasionally its weakness is excessive, and it requires special care and attention. This original weakness may be due either to premature birth, or to the fact of

* [Most young children will demand food oftener than thrice daily.—Ed.]

its being the child of a delicate mother. In this case its future welfare is doubtful. Such children demand of necessity a particular sort of hygiene, and intelligent, uninterrupted care, but through ignorance or neglect, these are frequently deficient.

The signs of congenital feebleness may be mentioned as follows : a child born in this condition weighs only about three and a half to four pounds, and sometimes still less. In other words, its weight scarcely equals one-half to three-fourths that of an ordinary infant born at the proper time. Even before weighing the infant, a probable judgment may be formed of its state by the following characteristic features : in such children the organs are unfinished, and the functions are incomplete. The skin is soft, delicate, and of uniformly bright red color. Its transparence is so great that occasionally the blood-vessels in it are distinctly visible. The cries are without vigor, and are acute and monotonous. The respirations are feeble and not very apparent, the chest-walls being almost motionless ; sometimes, indeed, unless we watch these movements closely during some moments, we might believe they had altogether stopped. More than once, mistakes have been made in this regard, which might have been followed by fatal consequences had they not been discovered in time.

Of all the muscular organs, the heart performs its work best, its pulsations being as rapid and strong as they were before the birth of the child. The infant continues in a half-torpid state and has not strength enough to take the breast without assistance.

The muscles of the cheeks, of the tongue and of the palate, are insufficient, and have not power enough to exercise suction. Swallowing is often slowly and imperfectly performed, and a portion of the fluids given are not swallowed. This symptom is always a grave one, since the life of the child largely depends on its being able to take sufficient nourishment at frequent intervals.

Such are the most apparent and accentuated features of original feebleness, examples of which will be encountered, at one time or another, by every one. By the side of the typical form of this condition there is an original state which may be compared with it, but which, on account of the cause, and the future prospect of the cases, differs from it. I refer to those children who are born small and thin, with a weight averaging from four to five pounds, and who present, nevertheless, an amount of energy and vitality which would never be suspected from their outward appearance. They are born at or near full term, but during intra-uterine life have not become sufficiently developed. Their nutrition has been imperfect, and their growth interfered with, owing to the influence of different causes. Very often they are the offspring of

mothers who, during pregnancy, have been attacked with some debilitating form of disease; or, without being ill, have been subjected to privations. These children, after birth, seem to be in a hurry to make up for their losses, or rather to reach the point where they should be. They take their mother's breast with avidity, and their appetite is almost insatiable. In this respect, they very much resemble hungry convalescents from a long and wearisome malady. Such children have, in fact, only the *appearance* of congenital feebleness. Their organs, although thin and small, have gone through the natural stages of development, and it is easy to perceive that they are ready to perform their functions.

The following may be said respecting the destiny of infants born prematurely: if, during the first few days following their birth, these children do not receive all the care their state requires, their speedy death is an assured thing. If such children are the offspring of intelligent parents, who are likewise in easy circumstances, the care which their condition requires is obtained for them, and very often they are then enabled to pass safely through the first weeks of life. In a brief period, owing to rapid development, the imperfections which result from the conditions surrounding their birth are permanently effaced, and they grow into a strong and vigorous childhood. To give an idea of the amount of congenital feebleness which is the sad heirloom of children of the poor, I will merely say that it has been estimated that one-half to two-thirds of the total number die during the first few months of existence.

It is not by the use of special drugs that we shall be able to effect the avoidance of the dangers of this condition, but it is by hygiene, or by a suitable adaptation of food, heat, and cleanliness to the wants of the infant.

Food.—This must consist exclusively of milk, and, if possible, of woman's milk. A nurse's is preferable to a mother's milk, because she is better able to supply the pressing needs of the infant during the first few days after birth. A nurse should be chosen whose nipples are prominent, of medium size, and well perforated, so that the milk may be made to spout readily. Whenever, in consequence of extreme weakness, the infant is unable to draw the milk, the nurse must press the milk from her breasts and allow it to flow into the child's mouth, only restraining an excess of it when she sees that the infant cannot swallow with sufficient rapidity. Of course the quantity of milk given at each nursing should be small, as the capacity of the infant's stomach is likewise small and its power of digestion is very feeble. Such an infant should take about one ounce the first day, and increase this quan-

tity by degrees until it takes one pint by the end of the first month, and one and one-half pints at the end of the second month, during the twenty-four hours. The rule is to give but *little milk at a time*, but give it *frequently*. The intervals of nursing should be at least every two hours during the day, every three hours during the night, and this should be persisted in for some weeks, even though it be necessary to awaken the infant in order to accomplish it. After that time the intervals may be lengthened somewhat, especially at night, since repose is necessary for the stomach, and there should be for it periods of inactivity when it is not obliged to digest. Of course, to measure *accurately* the quantity of breast-milk given is difficult, and the amounts above mentioned will serve merely as guides for the judgment.

Air is an essential food of the blood, and a feeble child must have *plenty* of it. This is not easily accomplished because its vitality is below par and its breathing is imperfectly performed. In the fine weather of spring and summer months, and after the child is one month old, it should go out of the house every day. Cold should be avoided, and during the late autumn and winter it is preferable to keep a feeble young infant in the house, at least until it is several months old. Great attention should then be paid to the ventilation of its chamber, where the air should be renewed daily.

Heat.—It is not enough that an infant who is born before full term, or in an enfeebled condition, should never be chilled. It should also be *kept* constantly warm. The feet, hands, nose, etc., are to be felt from time to time, and must be neither blue nor icy; for if this be permitted, respiration and circulation will both soon come to a standstill. In order to keep an enfeebled infant warm, it does not suffice to cover it with cotton-wool, flannel, etc. The sources of its natural heat must also be stimulated. The substances mentioned are mere protective agents. They do not furnish heat unless they have previously been heated. The infant must be rendered capable of producing heat itself. In order to effect this, recourse must be had to gentle friction, rubbing and kneading of the infant's body and limbs at regular intervals. All its clothes should be taken off, and it should be placed on the knees of the nurse near an open wood fire. The nurse's hand must be warmed and the palm moistened with a few drops of sweet-oil, or vaseline. Then the rubbing is begun: first the feet, afterward the legs, thighs, arms, trunk, etc. This kneading process excites the infant to contract its muscles, move its limbs, dilate its chest. Soon its skin becomes colored, warm, in a glow. These manipulations should last five minutes, and should be repeated three or four times in twenty-four

hours. The functions of circulation, movement, and respiration are awakened. The power of suction soon shows itself, and the baby becomes able to draw milk from the breasts. Let it be understood that the infant does not dislike these useful manœuvres, but shows signs of satisfaction in various ways.

Cleanliness.—An enfeebled infant must be kept especially clean and must not be permitted to breathe an atmosphere vitiated with filth. A warm bath (about 90° to 95° Fahr.) should be given it each day and should last three to five minutes. After its bath it should be carefully dried with warm, soft napkins, rubbed as before described and powdered around joints, in groins, between buttocks, etc. It should be frequently examined to see if its diaper be soiled, and should then immediately be changed and the soiled skin should be washed with warm water and a soft sponge, and then carefully dried and powdered. The cot, bed-linen, mattresses, etc., must be kept very clean and thoroughly aired every day or two.

Attention to the above hygienic rules will give surprising results, and at three months of age these enfeebled children will frequently enter upon a normal condition of bodily health and vigor. An opposite course will inevitably lead to most deplorable results.

BEVERLY ROBINSON, M.D.

Diseases of the Digestive Organs in Infancy and Childhood.

BY

J. LEWIS SMITH, M.D.,

OF NEW YORK,

VISITING PHYSICIAN TO CHARITY HOSPITAL; PHYSICIAN TO THE NEW YORK FOUNDLING ASYLUM AND TO THE NEW YORK INFANT ASYLUM; CONSULTING PHYSICIAN TO THE BUREAU FOR THE MEDICAL AND SURGICAL RELIEF OF THE OUT-DOOR POOR; CLINICAL PROFESSOR OF THE DISEASES OF CHILDREN IN THE BELLEVUE HOSPITAL MEDICAL COLLEGE, ETC., ETC.

DISEASES OF THE DIGESTIVE ORGANS IN INFANCY AND CHILDHOOD.

[BEFORE proceeding directly to a description of the diseases which are peculiar to the digestive organs of infants and young children, it will be serviceable to consider some of the peculiarities of the function of digestion in these immature persons and to explain the relative values of a few of the symptoms which are likely to attract a parent's attention when a child's digestion is deranged.

In a young infant the sense of taste, like other of the special senses, is far from being as active as it becomes a few years later; but its absence is in a small degree supplied by instinct, as in the case of the young of animals. While it will, therefore, take most naturally the milk from its mother's breast, it will, nevertheless, instinctively seize and suck with its lips and tongue any similar object, such as the end of a finger. Flavors of all kinds, unless they are quite decided, appear to be unappreciated.

It is not until about the third month that saliva commences to flow into the mouth of an infant, and even then it is thought by many physicians to be hardly capable of changing starch into the kind of sugar called *glucose*, this being one of the uses of saliva in adults. It is ordinarily three months later before teeth make their appearance, and at this time it is usual for the saliva to be considerably increased in quantity. At the same time the amount of mucus poured out by the glands of the mouth is also greater, and we then see a drooling or dribbling of saliva as one of the early evidences of the cutting of teeth. Until this flow of saliva has become well established, it is not proper to give an infant food containing starch in any form, since it lacks sufficient means for digesting it, and there is great liability that disturbance of the stomach and intestinal canal will result.

In adult life, muscular contractions of the stomach, during the presence of food in its cavity, serve an important purpose in causing a thorough mixture of its contents with gastric juice—a process which is very important in the proper digestion of solid food. In an infant, however, these contractions and movements of the walls of the stomach are very feeble, and it is, therefore, necessary that whatever food is taken should be in a fluid or nearly fluid condition. When milk enters the stomach, the cheese (or *casein*) contained in it is soon curdled by the acid gastric juice; but in the case of human milk these curds are usually soft and pulpy, and neither irritate the inner coating of the stomach nor resist the action of the gastric juice. The casein of cow's milk is apt, however, to form firmer masses of curd, and, in the case of infants with feeble power of digestion, these firm curds are hard of digestion, more irritating by their presence, and may either cause vomiting or may be carried into the intestine, where they undergo fermentation and decomposition, filling the belly with gas and causing diarrhœa or constipation or, alternately, both. In using cow's milk as food for young babies it is therefore sometimes found necessary to add to it a gruel of barley or a small amount of gelatine dissolved in water, so as to prevent the gastric juice curdling the casein so quickly, thereby securing its easier digestion; or, as hereafter mentioned, on page 498, the milk can be so treated as to get rid of a large proportion of its cheese while retaining its other elements.

In adults the secretion from the pancreas, which is emptied into the intestine immediately beyond the point where food leaves the stomach, is mixed with the pulpy mass, and, by its action on the fat which the food may contain, forms what is known as an emulsion—that is, the fat is separated into fine drops or oily particles, which float freely in the fluids containing them. This condition of minute division is necessary for the absorption of the fat from the intestine and its passage into the lymphatic or *lacteal* vessels from which it is discharged into the blood. Now, the natural food of an infant contains fat or cream in precisely this state of minute drops, and very little is required to be done by the immature digestive organs to fit it for absorption.

The inorganic substances in milk undergo no digestion whatever, but are taken up directly by the blood-vessels of the stomach and intestine, together with the watery portion in which they are dissolved. Sugar, which milk also contains, is so changed by the secretions of the intestine that it can also be readily absorbed by the minute blood-vessels.

It will from this be seen that the stomach of an infant should

serve mainly as a receptacle for holding a supply of food, the digestive functions which it is capable of performing being naturally but few as compared with those of an adult stomach.

In health most infants have from two to three movements from the bowel daily, and these are of a soft, pulpy nature, until the time for cutting the teeth has arrived. They are yellow when first voided, but quite liable to turn green when urine is passed at the same time and the two are together exposed for a while to the air. This green color is to be distinguished from that which is characteristic of diarrhœa, in which the movements are green when they are passed and have an appearance of containing chopped spinach.* If the casein contained in the milk taken by the infant has not been entirely digested, it can be noticed as firm lumps in the diaper.

Vomiting.

This is not usually so serious a symptom in an infant as it is in an older person. The most common cause is overfilling the stomach and is most likely to occur when the child nurses greedily, when the flow of milk from the nipple is rapid and abundant, and when it is allowed to nurse too frequently. Vomiting from these causes is probably not attended with nausea, and it is of no harm so long as only the excess of milk is thrown up. If it makes its appearance soon after nursing, it is still fluid as when taken, and, other things being natural, it is sometimes thought to be an indication of an abundance of supply. If it occurs a little later, it will have become curdled. It has often been noticed that vomiting like this is caused by laying a baby on its left side, in which position the liver, being uppermost, presses on the stomach and sometimes by its weight expels some of the contents.

Whenever a child has vomited in this manner, its mouth should be cleansed as well as its lips, in order that no curdled milk may remain there in contact with the air, to undergo fermentation and putrefaction, and favor the occurrence of inflammation of the mouth.

When vomiting is caused by the presence of firm masses of curd in the stomach, these may be expelled in long rounded pieces, due to their having been squeezed through the œsophagus (or gullet), and I have seen such lumps of cheese, as large as a finger, and hard enough to be picked up and thrown across the room without

* A small dose of calomel given to an infant will also cause the movements to become bright green.

breaking. This most often occurs when cow's milk, improperly prepared, instead of human milk, has been the food of the child.

Rocking in a cradle or in the arms will sometimes cause nausea, such as attends sea-sickness or swinging, especially when there is some indigestion, and it may lead to vomiting.

There are yet other causes more serious in character which should be borne in mind ; among these is the vomiting which takes place when a child has a *cough.* Little children rarely or never spit out the mucus coughed up from their air-tubes, but swallow it. This mucus is not digested, but after a time it causes nausea and is vomited. This act also helps to clear the wind-pipe at the same time of any mucus which may be in it. Indeed an emetic has not unfrequently to be given to infants who are not able by coughing to clear mucus from their air-tubes.

One of the early symptoms of *hydrocephalus,* or dropsy of the head, is vomiting. It appears to be entirely unaccompanied by nausea, and it may occur several times in the day. A marked peculiarity is the suddenness with which it takes place—like the spouting of water from a pump. When a child presents this form of vomiting, together with other symptoms, as described on another page of this volume (see **Hydrocephalus**), no time should be lost before consulting a physician.

Again, most of the *eruptive fevers* occurring in children are ushered in with vomiting. If a thermometer, such as is described in the Chapter on NURSING, be put into the bowel or arm-pit and kept for five minutes closely covered, it will at such times show that there is fever. The child will also be dull, or have headache, and may complain of nausea. In such cases the vomiting may be very difficult to control, but usually stops of itself when the disease is fairly established. This symptom is thought to be especially present in the onset of scarlet fever.

Prolonged *constipation, intussusception, hernia,* the presence of an excess of urea in the blood in consequence of disease of the kidneys, blows or falls upon the head, and the swallowing of poisonous substances may also cause vomiting.

Treatment.—When vomiting is caused by over-feeding, the remedy is simple and suggests itself. When it is due to sourness of the contents of the stomach, a teaspoonful of lime-water, or five to eight grains of bicarbonate of sodium or of potassium, or the same amount of subnitrate or subcarbonate of bismuth added to a couple of teaspoonfuls of milk, will be advisable, and may be repeated at each time of feeding. A small and hot poultice of flaxseed or corn-meal, to which a teaspoonful of mustard flour has been added, may be put over the stomach. Vomiting due to the

severer causes before mentioned should not be treated without the aid of a physician when one can be had.

Pain in the Bowels.

Pain in the bowels is most commonly shown by uncontrollable fits of crying, during which the face becomes white, the upper lip turns outward, and the corners of the mouth are raised. The smiles seen on the faces of babies during sleep, and which mothers and nurses are so fond of attributing to the effects of "angels' whispers," are, unfortunately, nothing more than spasms of the muscles of the face caused by mild attacks of belly-ache. Tears do not often flow in these attacks—indeed it is doubtful if an infant under three months of age has any to shed; but the temper of these children becomes, sometimes, almost unbearable. More or less active and forcible kicking, or drawing of the thighs up against the belly accompany these attacks of pain, and it will generally be noticed that at the same time the child's belly is bloated, and that it passes wind from the bowel. In these cases pain is caused by over-distention of the bowel with gas, which comes from fermentation of undigested food. At other times the pain may be owing to constipation or to some disease of the intestine, as hereafter described.

Still another cause of pain in the belly is *acute hydrocephalus*, which was referred to when speaking above of vomiting. In this disease, however, the belly, instead of being bloated, will usually be found to be flat or hollowed, and there will be constipation instead of looseness of the bowels, as is likely to be the case from indigestion.

The presence of *worms* in the intestinal canal gives rise occasionally, to pain in the bowels of older children. The ability of such children to talk will enable them to indicate the seat of the pain, and the other symptoms will be described on page 521.

It is a matter of experience among nurses that *cold feet* will give young infants a belly-ache, and that, when the feet have been warmed and rubbed before a fire and snugly wrapped in flannel, the colic will cease.

When pain is caused by indigestion, infants will often eagerly swallow whatever food is placed in the mouth, and seem to be ravenously hungry. The first effect of giving them the breast or bottle is usually to quiet them, but the food taken, especially when it consists of starchy substances, soon adds to the previous trouble, and the pains are rendered worse than they were before. It may be a hard trial of forbearance for a mother to

refrain from feeding her child at such times, but it would, in the end, be kinder treatment—indeed it may be said to be quite necessary—to give it the breast or bottle at longer intervals and in lessened quantity.

The treatment of pain in the abdomen depends, of course, upon the cause. When it is owing to bloating with gas or flatulence, rocking in a cradle is only of service so far as it renders the child giddy and stupefies it. The practice of holding a child in the arms, and then, while sitting in a chair without rockers, "chunking" it back and forth, together with "trotting" it on the knee of the mother, are rough measures for exciting action of its intestines and expelling the wind; but there are other, safer, and more agreeable methods which should be employed instead, since its crying *may* be due to the pain of an inflammation, a rupture, or an intussusception (see page 527), in which cases these methods would be of positive harm.

The domestic remedies, consisting of teas of sage, catnep, or anise-seed, or a drop of essence of peppermint (not the oil) in a teaspoonful of sweetened warm water, are by no means bad ones if not too much resorted to; but the most comforting thing (and something which can be used together with one or another of the above remedies) will be a large, light poultice of flaxseed meal, corn-meal, hops, or bran, made with hot water, covered with flannel, and applied over the entire abdomen as warm as it can be *comfortably* borne on the cheek or against the inside of the elbow of the person who makes it. This rarely fails to give speedy comfort and to be followed by expulsion of the gas which has caused the pain. A hot poultice will likewise relieve, more or less, the pain which attends more serious bowel troubles, and is therefore safe to resort to in nearly all cases.

These remedies should be the only ones used without the aid of a physician (unless I except one or two doses, if required, of five to fifteen drops each of paregoric given in sweetened warm water), since, as above shown, the crying and other symptoms may be owing to troubles of a serious character which require skill for their detection. Least of all should resort be had to soothing syrups, whiskey, gin, or opium in any other form than paregoric, as above mentioned. There is little doubt that multitudes of infants have been fatally drugged for stomach-ache, when other causes have been to blame, or when too powerful remedies have been used without competent judgment as a guide.

Constipation.

The consideration of this subject will be found on page 513.

The Cry of an Infant.

While speaking of this subject, in connection with pain in the belly, it may be well to refer here to some of the peculiarities which belong to the cry of an infant as indicative of certain conditions. This is the more desirable because many mothers and nurses are inclined to attribute every cry, which is not caused by a misplaced pin, to the existence of a "stomach-ache," and to treat it accordingly.

Within the first week after birth the urinary secretion is established, and an infant sometimes has a prolonged attack of crying resembling that which accompanies a true belly-ache. At such times it may be noticed that the urine stains the diaper a red or salmon color, and may leave a spot of colored sediment. This is due to small crystals of uric acid—one of the constituents of the urine—which have collected in the kidneys, and which are now being washed out by the early flow of urine. The age of the child and the presence of such a stain on the diaper will serve to distinguish this from pain in the intestine.

In the course of acute hydrocephalus, or dropsy of the head, children have a peculiar cry, more nearly resembling a shriek or scream. It takes place suddenly, sometimes when the child has been quietly sleeping. It does not always last long, but may be repeated at intervals. By striking its head, or pulling its hair; by boring with the back of the head into the pillow, or rolling it persistently from side to side, it will readily be seen that the head is the seat of the trouble. When the cry ceases (which may be soon), the child may at once go to sleep, and again awaken with the same sharp, long-continued cry.

Not unlike this cry is that which is made by children affected with disease of the hip or some other large joint. In these cases the pain is caused by spasm of the muscles in the neighborhood of the inflamed joint. It is most apt to occur spontaneously during sleep, but any sudden movement or jarring of the joint when the child is awake may cause it to scream in a similar manner.

Ear-ache, due to inflammation of the middle cavity of the ear or to a boil or abscess in the outer canal, is by no means of uncommon occurrence, and is often overlooked as a cause of crying in children unable to talk, until bursting of the drum-membrane or of the skin covering the abscess allows a discharge of matter to take place, and thus reveals the seat of trouble. The crying is apt to be severe, prolonged, and worse at night, and the child, by tugging or rubbing at its ear or the side of its head, may attract attention to the location of the pain.

Soreness of the buttocks from acid discharges from the bowels, or from diapers which are allowed to remain too long in contact with the skin after they are wet with urine. together with the itching caused by skin-diseases, are also provocative of much crying of a less intense character.

The cry caused by the prick of a pin or needle is usually sharp, violent, and continues as long as the irritation is kept up. The face usually becomes red or dusky, and the infant struggles with its limbs and entire body. Convulsions not uncommonly occur after the pain has continued for some time unrelieved.

The cry which accompanies teething is of an irritable character. and varies from a moan to a decided scream. If there is much irritation or swelling of the gums. the hands of the infant may be thrust into its mouth, and the reddened gums and dribbling saliva will direct attention to the source of trouble.

Infants suffering with diseases of the respiratory organs have a cry which resembles more nearly a groan or a grunt. and is repeated with every expiration. At the same time it will be observed that with each inspiration of air the nostrils open more widely than at other times.

The bites of fleas, bed-bugs, and mosquitoes should not be overlooked when a cause of crying is searched for.

Red-gum—Strophulus.

There is an erruption which is liable to appear upon the skins of young babies at any time before cutting the first teeth, and which sometimes causes mothers a great deal of anxiety until they know its nature. It begins in a red blotch, which is slightly raised at its centre above the adjoining skin. The color passes away after a time, leaving the central elevation larger and somewhat flattened. Another variety, called "*white gum*," consists of small white elevations, varying in size from that of a millet-seed to the bigness of a pin's head. The former appear upon the face, neck, arms and, it may be, upon the whole body. The latter are usually confined to the face and arms. These eruptions and *nettle rash* indicate either that the infant suffers from indigestion, or that it has been kept too warm.

Treatment.—Examine carefully any cause of indigestion. When that is removed, these troubles usually go away without treatment. So long as indigestion and excessive warmth continue, they are liable to stay in spite of any treatment. The burning and itching which attend them may be relieved by sponging with cold water in which bicarbonate of soda (baking soda) has been dissolved, in the proportion of a teaspoonful to a pint of water.—Ed.]

DISEASES.

Diseases affecting the digestive system are frequent in infancy and childhood. They are readily recognized, and, as a rule, are amenable to treatment, if their nature is understood and proper measures are employed sufficiently early. If they are neglected or improperly treated in their commencement, they may become obstinate and not unfrequently fatal.

Simple Inflammation of the Surface of the Mouth.

This disease commonly occurs before the close of the second year, and is especially frequent under the age of one year. Many cases are mild and overlooked. It is sometimes confined to a portion of the surface, while in other cases it is general, affecting the mucous membrane of the tongue, the gums, lips, and perhaps also the inner surface of the cheeks. Another name for it is *simple stomatitis.*

This inflammation, like other inflammations of mucous surfaces, is characterized by redness, thickening, or swelling (this being most marked upon the gums, especially around the teeth), increased secretion of mucus, and an increased production and casting-off of the delicate microscopic cells (epithelium) which cover and protect this, as they do all other mucous surfaces. The heat of the mouth is sometimes augmented in an appreciable degree. In severe cases the swollen and soft gums bleed easily when pressed, a light fur covers the tongue, and there is an increased flow of saliva, which, mingled with the mucus, dribbles from the mouth, and sometimes excoriates the lips. In mild cases there is little suffering, but in other instances patients are fretful, feel pain from the contact of solid substances, as food, and, if nursing, may wean themselves, from dread of pressure of the nipple. This disease terminates favorably with proper care and treatment, if there is no grave co-existing disease; but if the conditions are unfavorable, it may terminate in a more severe form of inflammation, as when ulcers are formed.

Causes.—The use of indigestible and improper food, and general anti-hygienic conditions, which cause derangement of the health and irritate or impair the digestive function, are common causes of this form of inflammation. Several years ago a Canadian, having good general health, received a gun-shot wound which laid open his stomach; in the healing a flap remained

which could be raised and the interior of the stomach inspected. Among the interesting observations made was this : that irritative changes produced in the stomach by indigestible substances were followed by redness and other appearances of irritation upon the surface of the mouth. The observations made in this interesting case established the fact, which physicians had already learned through experience, that irritation of the digestive organs, and especially of the stomach, is sufficient to produce inflammation of the inner surface of the mouth.

In young children any kind of artificial food is less easily digested than the breast-milk, and may, under certain circumstances, act as an irritant to the digestive organs. Hence, infants who are carelessly fed, or are prematurely weaned, are especially liable to this form of inflammation. The use of drinks too hot or too cool may also produce it by their local action, and it is also present in measles and scarlet fever.

Treatment.—It is important to ascertain the cause, and to remove it by appropriate hygienic and medicinal measures. If it have its origin in indigestion or irritation of the stomach and intestines, or inflammation, this should be relieved by change in diet and soothing and correcting internal remedies. The disease within the mouth will usually subside soon of itself when the cause is removed, but mucilaginous and mild astringent lotions may be required. Borax is a good remedy, used locally upon the inflamed surface in the proportion of one part to three or five of glycerine or honey, or one teaspoonful of powdered borax to two tablespoonfuls of water. One or the other of these should be applied every second hour to the surface of the mouth, by means of a large camel's-hair pencil. [As a mucilaginous lotion, flaxseed tea will be serviceable.—Ed.]

Ulcerous Inflammation.—Ulcerous Stomatitis.

This is simple stomatitis (or simple inflammation of the mucous membrane of the mouth), with the additional element of ulcers. The redness usually begins upon the gums and extends along the surface, not only of the gums, but of the tongue and cheeks. Little white points appear on the inflamed surface underneath the mucous membrane, causing slight prominences. These points are produced by the escape of fibrin from the blood. They enlarge and cause ulceration of the mucous membrane which covers them. Some of the ulcers are small and circular, while others are large and irregular. Sometimes two or more unite. This disease is

usually most severe upon the gums, and is often confined to their surface.

The causes are, to a certain extent, the same as those which produce the simple inflammation described above. An enfeebled state of the system, however produced, is a common cause. In protracted cases of fever and wasting affections of the intestines and lungs, this form of inflammation is apt to occur, and, if the system is much reduced, it is an unfavorable complication.

The symptoms in ulcerous stomatitis are more severe than in the simple form of inflammation. There are more tenderness, fretfulness, and greater flow of saliva. In severe cases infants nurse with reluctance, and sometimes wean themselves, and their breath often has an offensive odor.

Treatment.—It is important to remove the antecedent disease or the anti-hygienic condition which gives rise to the stomatitis. Cleanliness of the person and of the room and house should be enjoined. Tonic remedies, and measures designed to improve general health, are useful, as iron and vegetable bitters. For local treatment the remedy which is most highly esteemed by physicians is chlorate of potassium, except in the milder cases, in which borax answers. The chlorate must be used in weak solution : as two grains to the teaspoonful of water, to which a little honey or mucilage is to be added. A stronger solution causes smarting. A teaspoonful may be allowed to run over the surface, and swallowed every second hour.

Follicular Inflammation of the Surface of the Mouth.

This is inflammation of the minute glands or follicles, which secrete mucus, and with which the mucous membrane of the mouth is thickly provided. At first there appear minute elevations upon the surface, which are pointed, red and tender. These enlarge and are soon seen to contain a minute quantity of transparent liquid, probably mucus. This soon becomes turbid, and the membrane covering it breaks, leaving an ulcerated surface. From the commencement of the little elevation to its rupture only two or three days elapse. The ulcers are round, hard, and painful. They soon heal in ordinary cases, leaving a scar. The number of ulcers varies from six or eight to as many as twenty.

This disease most frequently occurs during the time when there is the most rapid development and the greatest activity of the mucous follicles which corresponds with the first dentition. This period in life is therefore a predisposing cause. The exciting causes are not often apparent. Habitual congestions taking their

origin in some errors of the digestive organs were regarded by Barrier as a common cause.

In most instances there is little disturbance of the general health. The ulcers are painful when pressed or touched, and therefore patients avoid solid food; and sometimes even drinks are painful, unless they are bland and unirritating. In its general appearance this disease resembles ulcerous inflammation of the same surface; but the inflammation is more frequently confined to the portions of the surface which immediately surround the ulcers, while the ulcers are circular and of nearly uniform size.

Treatment.—In mild cases in which there is no constitutional disturbance, and the ulcers do not run together but remain separate, patients soon recover with the use of soothing mucilaginous drinks, such as flaxseed tea and mild astringent lotions, as the ordinary solutions of borax (one teaspoon even full of powdered borax to one ounce of water). In exceptional cases, in which the ulcers enlarge and present an unhealthy appearance, additional treatment may be required; chiefly nutritious food, stimulants, and tonics.

Sprue, or Thrush.

This term is used to designate a form of inflammation, the distinguishing feature of which is the presence of points or patches of a curd-like appearance upon the inflamed mucous surface. Its usual seat is the mucous membrane lining the cavity of the mouth, but occasionally the sprue extends downward over the surface of the throat and even of the œsophagus. It never appears in the air-passages, and is seldom observed elsewhere, without occurring also and in a greater degree upon the surface of the mouth.

At first simple inflammation occurs. There next appears on the inflamed surface minute, translucent points, which increase and become white and opaque. Some remain as points, while others, extending and perhaps running together, form patches of greater or less extent, the central part of which is thickest and most prominent, while the borders are but little elevated. These patches are irregularly circular, and their highest elevation, which is in the central and first-formed part, is not more than one-twelfth of an inch in thickness. In their recent state they closely resemble particles of curdled milk; and the nurse often mistakes them for such, and neglects to call attention to them. They consist of the branches and sporules of a microscopic plant, the *Oidium albicans*, with the epithelial cells, etc., entangled between the branches. The roots of this vegetable growth penetrate the epithelial layer, even to the membrane in which it rests. In mild

cases these points of thrush are small and scattered. If the patches are large, so as to cover a considerable part of the surface, there is usually a reduced state of the system, involving danger, from some antecedent disease, as protracted diarrhœa, inflammation of the lungs, or tuberculosis.

The symptoms are like those of the simple inflammation. They are slight in mild cases, but in severe cases the surface is hot, red, and tender. There may be a free flow of saliva, or the tongue and adjacent surface may be dry, hot, and tender. The severer forms have been said by Valleix and others to be very fatal; but the fatal result is due chiefly to complications. Sprue on parts exposed to view is easily recognized. The patches of diphtheria are larger and firmer, and more closely adherent. Particles of curdled milk, which bear some resemblance to the patches of sprue, are easily washed away by drinks.

Treatment.—Improvement of the general health and attention to the diet are important. The nature of the infant's diet should be ascertained, and if it is faulty it should be corrected. Preference should always be given to the breast-milk for young infants. Older patients should have bland, unirritating, and easily digested food. On removing the cause, by improving the aliment, and, consequently, the general health, the cure is most prompt and effectual.

Sprue does not require constitutional measures. Patients recover with local treatment, if the anti-hygienic conditions which give rise to the disease are removed. The surface of the mouth should be washed every second hour with a solution of borax; one drachm to one ounce of glycerine and water, or with the mixture of borax and honey contained in the shops [and composed of a drachm of powdered borax to an ounce of strained honey]. This promptly destroys the oidium and effects the cure.

Gangrene of the Mouth.

The diseases of the cavity of the mouth, treated of in the foregoing pages, are comparatively unimportant; but gangrene of the mouth, though fortunately rare and observed only under unusual circumstances, is among the most fatal maladies of early life.

This disease is sometimes preceded by ulceration at the point where it is about to commence, but not always. It ordinarily occurs upon the inside of the cheek, and begins with thickening, hardening, and tenderness, indicating inflammation which extends beneath the mucous membrane into the tissues of the cheek. Soon the purple hue of gangrene appears upon the mucous membrane at the most prominent point, and extends. The part which

has lost its vitality separates, leaving an excavation of a greater or less size. The surface from which the decayed part has been detached is dark or grayish, and has an offensive odor, if the malady is not checked. Gangrene may be checked at any stage of its progress, but if it continues to extend it soon produces such destruction as necessarily involves a fatal result. Gangrene may commence upon the gum, where it soon causes loosening and loss of teeth, and even decay and casting off of the surface of the jawbone. In patients who recover, a scar remains for life.

The forms of inflammation of the mouth, previously considered, usually occur under the age of two years. Gangrene occurs, as a rule, between the ages of two and twelve years.

This malady is ordinarily secondary to some other affection, occurring in those who have been enfeebled by some exhausting disease. In a large proportion of cases it is a sequel of measles or scarlet fever.

Of forty-six cases, whose histories were collected by MM. Bouley and Caillault, in all but five, measles was the antecedent disease. Of the ninety-eight cases collated by MM. Rilliet and Barthez, the antecedent disease was measles in forty-one, scarlet fever in five, whooping-cough in six, intermittent fever in nine; typhoid fever in nine, mercurial salivation in seven, and inflammation of bowels in five cases. If there is no antecedent disease, gangrene of the mouth only occurs in those who have become enfeebled by some cause which seriously impairs the nutrition. Reducing treatment, and the abuse of mercury, was once a more common cause of gangrene than at present. Mercury is now seldom employed in treating the maladies of infancy and childhood, and supporting rather than depressing remedies are commonly used.

Obviously, from what has been stated, the symptoms usually indicate weakness and faulty nutrition. The features are pallid, and have a melancholy expression. Some patients are fretful, but others quiet, unless when disturbed. The suffering is not in proportion to the dangerous character of the malady. The pulse is accelerated, and there is some fever. The appetite is poor, or sometimes tolerably good, but the nutriment must be chiefly or entirely liquid. There is usually considerable thirst but no vomiting or derangement of the bowels, unless from a complication. When the vital forces are reduced, and especially when the fatal result approaches, the surface presents an ashy appearance, and, finally, the limbs become cool, notwithstanding active stimulation.

Treatment.—Since, in cases of this form of gangrene, debility

is a prominent predisposing cause, the patient should be removed from the influence of all depressing agencies or conditions, and tonics with the most nutritious diet be prescribed. Both the vegetable tonics (as gentian or cinchona, in doses of half a teaspoonful of the tincture, given in a little water every four to six hours) and preparations of iron (as tincture of the chloride of iron, in doses of ten drops, given every four hours in glycerine and water) are needed. This form of gangrene requires similar local treatment to that which surgeons are in the habit of employing for gangrene resulting from inflammation in other parts of the system. The diseased parts should be freely bathed with a solution of carbolic acid, in the following formula :

Carbolic acid	One drachm.
Glycerine	Three ounces.
Water	Five ounces.

Mix.

This should be used every two or three hours, so as to destroy all gangrenous odor, and stimulate the surface to a more healthy action.

The strength of the solution may be made greater, but it should not be used so as to cause pain, unless for a short time.

In some of the New York hospitals pure bromine is applied to the gangrenous surfaces. It is an antiseptic, and it was found useful in army practice during the war of the rebellion. It is probable that it would also be useful in gangrene of the mouth.

It is almost needless to say that a disease so terrible as this will require the careful attention of a physician, and should not be undertaken by any irresponsible person.

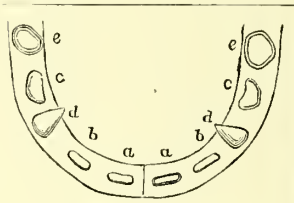
Teething—Dentition.

The opinion which has been prevalent in the community, and is still held by many, that dentition is a cause either predisposing or direct of many infantile maladies, is erroneous. This belief. which was current when the nature of diseases was less understood than at present and diagnosis was more difficult, has lost its hold on the minds of medical men, and now has little influence on medical practice. A large proportion of the intelligent and experienced physicians of the present time consider dentition an unimportant cause of disease ; they regard it as a cause only in unfrequent and exceptional instances. But there are some physi-

cians who still hold that tardy and painful evolution of the teeth, accompanied by swelling and tenderness of the gums, should be regarded as a factor in the production of certain maladies, especially those of the nervous and digestive systems, even when the organs affected are situated at a distance from the mouth.

It is important to understand the exact relation of teething to infantile diseases ; whether the former be a cause of the latter, and if so, to what extent. Every physician is called, at times, to a case of serious disease which has been allowed to run on without treatment, in the belief that the symptoms were the result of dentition. Thus I have known inflammation of the covering of the brain (*meningitis*), inflammation of the lungs, and of the intestines, to be overlooked even by physicians of experience, the symptoms having been carelessly attributed to teething. In cities many infants lose their lives from neglected diarrhœa, especially during the summer months, the friends believing it to be a symptom of dentition, and a relief to it, till they become alarmed by the loss of flesh and strength, and finally seek medical advice.

I shall endeavor to point out what is really ascertained in reference to the relation of dentition to diseases : The first dentition, or that of infancy, commences about the age of six months, and ends at the age of two and a half years. The corresponding



Age.	Teeth cut.	Total No. of Teeth.
7th month.	Central incisors (*a*).	4
9th month.	Lateral incisors (*b*).	8
12th month.	Anterior molars (*c*).	12
18th month.	Canine teeth (*d*).	16
24th month.	Posterior molars (*e*).	20

teeth of the two sides pierce the gums about the same time. The two lower central incisors appear about the age of six or seven months, followed, in the order in which they are mentioned, by the upper central incisors, upper lateral incisors, lower lateral incisors, the four anterior molars, the four canines ("eye" and "stomach" teeth), and, lastly, by the four posterior molars. The incisors usually appear in rapid succession, so that all are in sight by the age of one year. The anterior molars appear between the ages of one year and sixteen months, the canines, from the sixteenth to the twenty-fourth month, and the posterior molars, which complete the first dentition, from the twenty-fourth to the twenty-eighth month. This order is not always preserved. Dentition may commence at an earlier age. Teeth have been observed even

at birth, but retarded teething is more common than premature teething. Those who have rickets, or are feeble from birth or by disease, often have no teeth till considerably after the usual period. In rickety children the first incisors may not appear till the age of twelve months, or even later. [See also, chapter on The Mouth.]

The evolution of the teeth is attended by more or less swelling of the gums, but some teeth cause more swelling than others. Thus the superior incisors cause more swelling than their corresponding teeth of the lower jaw. This swelling of the gums is, within certain limits, physiological, but beyond these limits an actual inflammation of the gum, or *gingivitis*, occurs, which is the simplest diseased state resulting from dentition.

Sometimes the inflammation extends along the surface of the mouth from the sac inclosing the tooth, producing inflammation of the mucous membrane of the mouth. In a few instances I have known such a degree of inflammation over the advancing tooth that a small abscess formed, producing pain and tenderness, until it was opened by the lancet.

There are other ailments of organs or parts located at a distance from the mouth, which have been more or less attributed to dentition. Their occurrence has been explained by the fact of the intimate relation and inter-dependence of organs through the system of nerves. Infants, during the time of teething, frequently have diarrhœa; but this is probably not so much due to dentition as to the fact that in the same period there is unusual activity and development of the intestinal follicles.

It is, I believe, true also, that in most cases of diarrhœa which have been attributed to dentition there are other causes, such as unsuitable food, residence in an unhealthy locality or in a city during hot weather. I am convinced that in a large proportion of the cases in which diarrhœa is supposed to originate from dentition, the latter is, to say the most, only a predisposing cause of the former, and that cases are very exceptional in which dentition is the *chief* cause of the disturbed action of the intestines.

The convulsions of infancy are often attributed to dentition, but in most cases in which they occur during teething, careful examination discloses other causes besides the state of the gums. In the vast majority of instances, teething can only be considered as a predisposing cause, by producing a sensitive state of the nervous system, so that convulsions are the more readily produced by exciting agencies.

Rarely do convulsions appear to occur mainly from dentition, or, if there are other causes, they seem to be subordinate. This

may happen when several teeth are about protruding, and the gums are more swollen and tender than is usual from dentition. Thus, in one case which I observed, two convulsions occurred with an interval of a few days, in an infant not subject to them, at the time when five teeth were about protruding and the gums were much swollen over them. These attacks were not severe, and careful examination disclosed no other cause. Previously, and since, this infant has been free from convulsions.

A few years since, the disease called "infantile paralysis" was supposed to be due to difficult and painful dentition, and it was sometimes designated "dental paralysis;" but it is now known that the different forms of paralysis to which infants are liable have other causes quite distinct from dentition. [See, also, **Infantile Paralysis.**] It is seen, therefore, that dentition bears a much less important part in the causation of infantile diseases than was formerly supposed.

Treatment.—It is obvious that an infant suffering from symptoms, such as dentition is supposed sometimes to produce, should be examined by a physician, and in the majority of such cases the cause will be found entirely distinct from the teething process.

Diarrhœa, occurring during dentition, should receive the same treatment as at other periods of life. The number of evacuations from the bowel should be reduced to two or three daily, by appropriate measures. It is well that persons, who believe that diarrhœa is salutary during teething, should know that this number is quite sufficient, and that more frequent evacuations will endanger the safety of the child.

The nervous affections, as convulsions, require such measures as physicians are able to prescribe. The bromide of potassium, bromide of ammonium, or bromide of sodium, I have found especially useful and safe in cases of fretfulness and nervous excitement due to dentition, and they may be given in doses of five grains of either at intervals of four hours, dissolved in a little milk or water. Demulcent and soothing lotions are sometimes useful (such as flaxseed tea, marsh-mallow tea, or borax water made of a strength of a drachm to an ounce of water). The infant may be allowed to hold in the mouth an india-rubber or ivory ring, which by pressure on the gum appears to give considerable relief. Mothers will often attempt to "rub through a tooth," as they term it, by means of a ring or thimble. This should be discouraged. So great friction cannot fail to have an injurious effect, by increasing the swelling and inflammation, unless the tooth has already reached the mucous membrane.

[The baby's thumb is an instrument which nature has provided

for this purpose, and it has but little other usefulness at this time of life.—Ed.]

M. Trousseau several years ago pointed out the fact that teething does not produce tension of the gums, since the edges of the wound, when the lancet is used, do not retract, but remain nearly in contact, and, unless the tooth is ready to protrude, the cut surfaces unite within two or three days. The resistance opposed by a gum to a growing tooth is probably less in degree and less painful than many suppose. Teeth of the first dentition undergo gradual absorption by the pressure of those of the second dentition, often without producing pain or other symptoms. Why, then, should the fleshy substance of the gum undergo difficult absorption, so as to require the lancet to relieve the pressure and release the tooth ?

Too much importance has evidently been attached to the supposed tension and resistance of the gum. When the symptoms are not urgent, and the highest point of the dental crown is not yet visible in the gum, it is not proper to cut, for the incision closes in two or three days, and any good which might result from the operation would therefore be but temporary. I can recall but two accidents of dentition which require the use of the lancet, namely, suppuration of the gums and convulsion. All other ailments which were formerly attributed to dentition should, in my opinion, be treated without attention or regard to the state of the gums, and in convulsions I would not, ordinarily, consider it advisable to use the lancet until the usual measures of relief had been employed and had failed. The free use of one of the bromides of potassium, ammonium, or sodium by the mouth—aided, perhaps, by the use, also, of hydrate of choral by enema, as directed in the following formulas—have so uniformly put a stop to infantile convulsions that I have not found it necessary to use the gum-lancet during the last three or four years in the treatment of quite a large number of cases.

Bromide of potassium	five grains.
Cold water	a tablespoonful.

To be given at one dose, and repeated, if necessary, at intervals of half an hour.

Chloral hydrate	five grains.
Warm water	two tablespoonfuls.

Dissolve, and, by means of a syringe, throw it into the bowel.

Indigestion.

In adults the digestive organs are capable of assimilating a great variety of food, but it is necessary for the well-being of young

children that the diet should be simple and carefully prepared. Departure from this rule of feeding leads to indigestion and perhaps to other diseases. For infants under the age of twelve months no nutriment is so good as the breast-milk, and every mother should suckle her own infant unless there be good physical reasons to the contrary.

The specific gravity of healthy human milk is about 1032 ; it has a sweetish taste, a bluish-white color, and is alkaline. If the mother is sick, or her health impaired in any way, it may be acid and otherwise changed, so as to be digested with more difficulty. The mother's milk during the first few days after the birth of the infant contains more solid matter, especially salts and fat, than is present subsequently, and it also contains large corpuscles, termed *colostrum*. This first milk acts as a purgative, and expels from the bowel the dark substance, designated *meconium*, which collects before birth in the intestine. But sometimes the milk contains colostrum for a much longer period, when it is apt to produce vomiting and diarrhœa, or other symptoms of indigestion, in the infant.

Strong mental excitement in the mother sometimes changes the character of the milk, so that it may cause indigestion. It is said to render it thinner, like whey, and to diminish the proportion of sugar ; and the milk thus altered may cause vomiting or diarrhœa. The reappearance of the "monthlies" has a prejudicial effect on the milk, diminishing its solid ingredients, and sometimes deranging the digestive function of the infant. If the indigestion which it produces is limited to the menstrual period, little harm results ; but if the milk is permanently changed after the re-establishment of the "monthlies," so as to be with difficulty digested, as is shown by vomiting, diarrhœa, or wasting in the nursling, a change in the mode of feeding will probably be necessary, either to a wet-nurse or to the bottle. But many nursing infants appear to do as well, or nearly as well, during the monthly periods as in the intervals, so that too much importance must not be attached to this function in the mother, as a sign that weaning is required.

Pregnancy tends to lessen the value of the milk, and the mother in this condition should ordinarily wean, or shorten the period of nursing. The proper development of the unborn child, and regard for the mother's health, at least, require it.

A mother who is consumptive or scrofulous, or who is reduced by any severe disease, should not be allowed to suckle her offspring. Her milk, when her health is seriously impaired, is apt to be insufficient, or its quality so changed as to affect injuriously the

digestive function of the infant. But in the city, weaning should be avoided in the hot months, and during the eight or ten weeks which immediately precede them, whatever be the condition of the mother, since weaning at this time greatly increases the liability to the so-called "summer complaint" or infantile diarrhœa, of the hot months, which is so common and fatal in city families. Under such circumstances a wet-nurse should be employed, or the infant should be removed to the country and weaned there.

Indigestion may be habitual either in consequence of feebleness of the digestive function, or, as is more frequently the case, in consequence of the habitual use of food which is unsuitable for the age of the child, or is of poor quality. In other instances the digestive function is, ordinarily, well performed, but from some temporary derangement of system, or error of diet, an acute attack of indigestion occurs. Hence two forms of this ailment are described: first, *acute*, referring to temporary attacks; secondly, *chronic*, referring to the habitual state.

The infant with chronic indigestion, whose food, whether breast-milk, or artificially prepared, continually disagrees, is fretful. It has a discontented aspect. It seldom smiles, and is not amused by playthings, or is less readily amused than other children. Its features are pallid, and bear the appearance of faulty nutrition. Its body and limbs waste, or become soft and flabby. It vomits frequently, and sometimes lumps of curded cheese are ejected, which have evidently lain in the stomach for a considerable time; the bowels are constipated or loose. In addition to the habitual indigestion, these infants often have acute attacks, similar to those in the adult, and which are sometimes designated *gastralgia* (stomach-ache), or *enteralgia* (belly-ache). Their countenances, in the attacks, indicate suffering; they utter sharp cries, and their thighs are drawn over their abdomens.

Sometimes young mothers, anxious that their infants should thrive, overfeed them. They suckle them too frequently, or in addition to the breast-milk, which may be quite sufficient, they give cow's milk or pap at short intervals, and if the infant fail to vomit the surplus food, and the latter undergo acid fermentation, it gives rise to pains in the belly and unhealthy stools. Indigestion from overfeeding, which is the result, may be removed by proper regulation of the diet, with little or no medicine.

Dietetic Treatment.—There is need that mothers should be instructed in reference to the feeding of children, for much of the indigestion of infancy and childhood may be prevented by the use of suitable food, given at proper intervals. The infant, during the first two weeks, should take the breast as often as every half

hour, or every hour ; but after the age of two weeks it should be accustomed to take the breast every two hours in the daytime, and about every three hours at night. Until it has reached the age of three or four months, no other food should be given, if the breast-milk is sufficient, unless during times of temporary indisposition of the mother. After the age of three months, a light pap may be allowed at intervals during the day in addition to the breast-milk. That made with Ridge's Food or Robinson's Barley and fresh country milk, is among the best. After the age of six months the pap can be made of wheat-bread, not too fresh, and a little beef-tea, plainly made, may be given each day. Weaning should take place, as a rule, at about the age of twelve months, but the infant remaining in the city should never be weaned in the summer months, nor in the eight or ten weeks immediately preceding them, since the change of diet at this time increases greatly the liability to the diarrhœal maladies which are so common and fatal in cities during the summer season, as we have stated above.

If for any reason the mother is unable to suckle her infant, a wet-nurse should, if possible, be employed, especially if the family live in the city, since artificial feeding is the fruitful source of diarrhœal maladies in city infants. If artificial feeding is necessary, or resolved upon, then great care is requisite in order that the food shall contain the proper amount of nutriment, and not disagree with or over-tax the digestive function.

Cow's milk, as it is easily obtained and bears a close resemblance to human milk, is very properly employed, both in the country and city, as the common food for infants when it is necessary to feed them with the bottle. It however contains less water, butter and sugar, and more casein and salts than human milk ; but the butter has a less, and the casein a greater, specific gravity than the mass of the milk, so that if it be allowed to stand for an hour or two, the upper third be then removed, with a little water added to it, it closely resembles human milk. During the first month about one-third water should be added ; in the second month one-fourth water ; and after the third or fourth month the milk may be given without dilution.

Cow's milk, like human milk, should be slightly alkaline, and when it can be obtained only once each day, a little bicarbonate of potassium may be added to it, especially in warm weather, to insure its alkalinity, and prevent its souring. Milk from healthy cows, which have pasturage in the country, or are fed on hay, should be procured, for the quality of the milk depends greatly on the kind of food. Cows, stabled in the city, and having food of poor quality, such as stale vegetables and distillery grains, often give milk

which has an acid reaction even when fresh, is deficient in nutritive properties, and is therefore unsuitable for use in the nursery. During the first half-year the infant is most conveniently fed from the nursing-bottle, which, with the tip, should be thoroughly washed after use, and be placed, when not in use, in cold water containing a little bicarbonate of sodium or of potassium.

In the city it is often difficult, in the hottest weather, to preserve milk which is brought from the country, so that it will be proper for use, till the next morning. To obviate the difficulty, condensed milk is used in New York, as it sours less readily than the ordinary milk. Scientific investigation has also resulted in the preparation of a food which contains nitrogenous and non-nitrogenous ingredients in the same proportion in which they exist in the best human milk, and which is therefore offered in the market as the best substitute for the breast-milk, when the latter is not available. The preparation of this food was one of the latest labors of the renowned Liebig, whose name affords sufficient guarantee of its excellence. Hawley's, Horlick's, and Mellins's preparations of Liebig's Food are found in the shops, and are good substitutes for breast-milk for infants under the age of four or five months.

They contain little or no starch—which is digested with difficulty by young infants. Ridge's Food, Nestlé's Lacteous Farina, Jewell's Food, etc., are in common use for infants who have passed beyond the third or fourth month, and barley-flour is also a good food for such. An artificial food which agrees with one child often will not agree with another, so that it is sometimes necessary to change a diet, which is suitable for most infants, but is found to disagree with certain others.

Medicinal Treatment.—The first indication in treatment is obviously the removal of the cause. In acute indigestion, when there is reason to think that there is some offending substance in the stomach or intestines, measures should be employed to effect its removal. If the substances which cause the distress are solid, and recently taken, a mild emetic, as a teaspoonful of syrup of ipecacuanha, may be employed ; but if a longer time have elapsed, a purgative, as castor oil, or an enema of soapsuds is required. Sometimes the pain in acute indigestion is so severe as to require the use of an opiate, such as five to fifteen drops of paregoric in sweetened water. In the infant, there is often excess of acid in the stomach and intestines, which causes the pain, and this is best treated by alkaline remedies, as a little lime-water or baking soda with the paregoric.

If the infant, nourished at the breast, suffer from chronic or habitual indigestion, the milk should be examined with a micro-

scope and otherwise, and the state of health of the mother or wet-nurse and the character of her diet should be ascertained. The change from the milk of the mother to that of a wet-nurse, or a change from one wet-nurse to another, may often be advisable.

Bottle-fed infants suffering from habitual indigestion require the utmost care as regards the character and preparation of their food and the time of feeding. Sometimes removal to a more salubrious locality, as from the city to the country, especially in the summer months, is followed at once by improvement in the digestive function, and relief of the indigestion.

Children with chronic indigestion are occasionally much benefited by the moderate and judicious use of alcoholic stimulants, as a few drops of brandy, or twice as much sherry with a little water. They should be given sparingly and with food, and should be discontinued as soon as the digestive function is fully restored. Some French writers recommend the habitual use of wine for infants, even in the state of health; but there are reasons, moral as well as physical, why alcoholic stimulants should only be used as medicines, and not in health. Tonics are often required to improve the digestive function, such as twenty drops of the elixir of calisaya bark or other preparations of Peruvian bark, or a similar dose of tincture of gentian or columbo, given in a little water before meals; powders of pepsin, combined, if there is an irritable stomach, with bismuth, or the acidulated liquid pepsin given before each meal, is also useful to restore digestion.

Muriatic acid, which is a normal element in the gastric juice and with which the liquid pepsin of the shops is acidulated, appears of itself to aid materially in digestion [and may be given by itself in doses of two to five drops of the dilute acid in water, after eating.]

In chronic indigestion, associated with subacute or chronic diarrhœa (for this form of inflammation is common in infantile indigestion) there are certain remedies which are useful for the indigestion, and at the same time are useful or not injurious for the catarrh. Among these may be mentioned pepsin with bismuth, or colombo, and the solution of nitrate of iron.

Pepsin	forty grains.
Subnitrate (or subcarbonate) of bismuth	forty grains.

Mix and divide equally into five powders, one of which may be given with milk or water before meals.

Solution of nitrate of iron	eighteen drops.
Tincture of columbo	two drachms.
Simple syrup	two ounces.

Mix, and give a teaspoonful every third hour.

Diarrhœal Maladies.

Diarrhœa is, with one or two exceptions, the most frequent disease among young children. In most instances it is due to one or two causes, namely, either taking cold, or the swallowing of food or substances which irritate the intestinal surface.

Simple Diarrhœa (*Not Inflammatory*).

Many of the cases of diarrhœa thought to be simple are really inflammatory, and many cases beginning as simple diarrhœa become inflammatory by the continued operation of the cause. A common cause of this malady is the use of unsuitable food. Indigestible food is apt to stimulate the intestinal follicles to excessive secretion, and hasten the action of the intestines. In infants diarrhœa is sometimes due to too frequent feeding, the food not needed for nutrition acting as an irritant, and producing green and unhealthy evacuation. Even the breast milk may disagree with the infant, and produce a laxative effect upon its intestines in consequence of temporary indisposition of the mother or wet-nurse, or her habitual ill health. The common cause, except in cases due to the presence of some irritating substance in the intestines, is catching cold. Diarrhœa is occasionally salutary within certain limits, and of course it is not strictly correct to call it a disease, when it is a means of relief. If occurring from an excess of food, or from an irritating substance in the intestines, it serves to expel it.

Symptoms.—Diarrhœa may come on abruptly; at other times it has a premonitory stage continuing for some days. If the diarrhœa occurs from "catching cold," or from some indigestible aliment, it commonly begins abruptly. Among the premonitory symptoms sometimes present, are restlessness, disturbed sleep, transient abdominal pains, nausea, or vomiting, and other symptoms of indigestion. The stools in this affection differ much in color and consistence in different patients, and sometimes in different periods in the same patient. In infants they are apt to be green. This color, which is a source of anxiety to the inexperienced, and especially to parents, is often produced by trivial causes. Slight indigestion will cause it, and so will excess of food even though it may be the most bland and unirritating.

The stools in the diarrhœa of infants often contain particles of coagulated casein, but in children advanced beyond the period of first dentition they do not differ materially from the evacuations of the adult. The features in this disease are pale, and in a few

days, if the evacuations continue, there is evident loss of weight and flesh. The plumpness of the limbs is gradually lost, and the flesh becomes soft and flabby. But in most cases, when the malady has reached this stage, its original character is lost and it has become inflammatory.

Treatment.—It is necessary, in order to treat diarrhœa in infancy and childhood successfully, to ascertain the cause, and, so far as possible, to remove it. *It is not till the cause ceases to operate that we can expect a satisfactory result from the use of medicine.* This remark is especially applicable to the diarrhœa of infants. With them, very generally, when affected with this complaint, there is some fault as regards the quantity or quality of their food. Attention to this matter will show the need of a change of wet-nurse, or, if the infant be spoon-fed, a change in the character or mode of preparation of its food, or even in the quantity given. Sometimes, by change in the diet, and the adoption of hygienic measures, the complaint ceases so as to require no medication. If medicines are needed, and the symptoms are not urgent, it is occasionally advantageous to commence treatment by the use of one of the milder purgatives, as castor oil in a small dose. Half a teaspoonful to one teaspoonful of castor oil, or a proportionate dose of calcined magnesia mixed with water or milk, removes any acid or irritating substance from the intestines, and is followed by diminution in the number of stools. If there have been previous constipation and the diarrhœa have just commenced, a purgative is obviously indicated, and no purgative for this purpose is better than castor oil. Some physicians have treated diarrhœa by small doses of such a laxative administered daily, but the instances are very few, in my opinion, in which this treatment is proper, and in which the use of purgatives is advisable, except in one or two doses for preliminary treatment. The correct treatment, with few exceptions, consists in the use of opiates, astringents, and, in infants, sometimes of alkalies [but this matter ought always, when possible, to be left to the advice of a physician].

The compound powder of chalk and opium is a useful remedy to control the evacuations. It may be given in three-grain doses every three hours to a child of one year. The following is a convenient formula for administering, substantially, the same medicines in a liquid form :

Deodorated tincture of opium..................	Sixteen drops.
Subnitrate of bismuth..............	Two drachms.
Simple syrup..................................	Half an ounce.
Chalk mixture.................................	One and a half ounce.

Shake well before using, and give one teaspoonful every third or fourth hour.

In a large proportion of cases I employ this prescription, or one equivalent to it, from the first visit. If the patient is not relieved by it, and by proper regimen, the case is in all probability one of inflammation. In patients over the age of two or three years, simple diarrhœa approaches in character that of the adult, and requires similar treatment, allowance being made for the difference in age. Alcoholic stimulants are commonly required in this malady, and in infants they are needed from the commencement of the diarrhœa, in order to prevent *spurious hydrocephalus* and other accidents which are liable to arise from exhaustion. [Ten to fifteen drops of brandy or whiskey, or twice as much sherry, added to a little sweetened water, may be given every hour to an infant under one year of age. Ed.]

Inflammatory Diarrhœa—Intestinal Catarrh.

This is one of the most common and fatal maladies of early life. It occurs in all climates and seasons, and it is the great summer epidemic of cities, causing a larger mortality during the hot months, in the large cities of the United States, than is produced by any other disease.

A common cause of this catarrh, operative in all localities and times, but most frequently in cool and changeable weather, is catching cold. Infants who are carried from warm to cold rooms without sufficient precautions, or who are exposed by heedless nurses to currents of air with insufficient clothing, are especially liable to be attacked. Another common cause already alluded to is the habitual use of indigestible and, therefore, irritating food. This is not infrequently either the sole or an efficient co-operating cause during infancy. The influence of the summer season, as a cause already alluded to, is forcibly shown by the statistics of this city (New York), in which I find, from the mortuary statistics, that during five years over nine thousand young children, chiefly infants, perished from the diarrhœal maladies between the first of June and last of October. Indeed there is no disease so prevalent and fatal, with the possible exception of consumption, as the intestinal catarrhs of infants occurring during the summer months in the large cities of the United States.

This summer epidemic of cities commences about the middle of May, and from this time there is a gradual increase in the number affected, till the months of July and August, when the disease attains its greatest prevalence and mortality. During September and October there is a gradual abatement in the number and severity of the cases, till the malady ceases or becomes infrequent in the cool weather.

It is seen that its prevalence bears a close relation to the degree of summer heat; but that the latter is not sufficient in itself to produce this catarrh is obvious. In elevated localities in the country there may be a high degree of summer heat for many weeks, and yet in such places this disease is not common. It is, without doubt, the noxious exhalations from various sources in consequence of the heat, with which the atmosphere is loaded, which render intestinal catarrh prevalent and fatal among city infants during the heated term.

But there is another important cause, namely: the diet. Many an infant that now falls a victim would escape but for some fault in the nature of its food. Infants in the city under the age of one year, who are bottle-fed, rarely go through the summer without being affected with diarrhœa, and a majority of such have dangerous, if not fatal, intestinal catarrh before the warm weather closes, unless removed to the pure air of the country. In the families of the poor the food, which is given as a substitute for the mother's milk, is very apt to disagree with the infant. The milk of city-fed stabled cows is greatly inferior to the milk of healthy and well-fed cows of the country, in the proportion of its ingredients and sometimes in its chemical character. Infants to whom this and other improper articles of diet are given are the first to suffer from diarrhœa as the warm weather commences, and finally they are attacked with intestinal catarrh.

It is seen that the causes of intestinal inflammation of infants, as it occurs in the cities during the summer, are mainly two-fold, namely: atmospheric and dietetic—an unhealthy state of the air which the infant breathes, and unsuitable food. And since, among poor families, both these causes co-operate, it is evident why their infants suffer so severely from this malady.

The common and popular belief that teething is a cause of intestinal catarrh, and is largely instrumental in causing the diarrhœas of the summer season, is based on an error of observation.

It is during the time of dental evolution that infants begin to be spoon-fed, and those young infants who have not reached the teething age are even more liable to intestinal derangement and catarrh under the same atmospheric and dietetic conditions than are teething children, as I have learnt from many observations, so that an infant of four months who is not yet teething is more liable to be affected than one of seven or eight months who is cutting the first teeth. Teething is therefore not to be regarded as a cause, or it is one of a very subordinate nature.

It is obvious that the matter of *weaning* and artificial feeding sustains a very important causative relation to this catarrh. The

summer months succeeding the change of diet is always a time of great danger, in consequence of diarrhœal affections, to infants who remain in a city. Mothers in the city uniformly speak with dread of the second summer, in which most infants are artificially fed. In New York City nearly every infant under the age of one year, taken from the breast between the months of July and October, becomes affected with intestinal catarrh, unless removed to a healthy locality in the country.

Symptoms.—Intestinal catarrh in the infant, whether produced by catching cold, errors of diet, or the influence of the summer season, is announced by the occurrence of lassitude, feverishness, and, perhaps, fretfulness, soon followed by diarrhœa. The stools are more watery than in health, and their color is yellow, brown, or green. Infants having a milk diet are apt to pass green and acid stools, containing particles of undigested casein.

In the beginning of the catarrh the tongue is moist and covered with a light fur. At a more advanced stage it may be moist, but is often dry and, in dangerous forms of the malady, the inner surface of the mouth is red, the gums are swollen and sometimes ulcerated, and frequently sprue appears upon the tongue, gums, and neighboring parts. Vomiting is a common symptom, commencing in some cases early, but in others not till the diarrhœa has continued some days.

When it occurs early it is often due to the acid in the stomach. contained in its contents or produced by fermentation. Occurring later, it may show that the brain is becoming involved, or it may then be due to impaired function of the kidneys, in consequence of which urea ordinarily thrown off by these organs is retained in the system so as to be secreted in the stomach, where it causes nausea. The matter vomited, especially when the vomiting is due to an excess of acid in the stomach, has a sour odor, and produces a decidedly acid reaction when brought in contact with blue litmus-paper. It contains coagulated casein and undigested particles of whatever food has been given. I found, from observations made in reference to the diarrhœa of infants, in the summer of 1863 and 1864, that vomiting commenced in less than a week after the diarrhœa in the majority of cases.

The stools sometimes continue, during the whole course of the catarrh, of nearly the same character as at first. In other patients they vary in color and consistence at different periods, this change being due partly to the nature of the food. In the same patient they may be brown and offensive at one time, green, like mashed spinach, at another, and again of a putty-like appearance, from partly digested casein. They may consist largely of mucus,

with or without blood, such stools indicating a predominance of inflammation in the lower portion of the intestine.

The malady, which Barrier designated mucous diarrhœa, is located chiefly in the lower part of the intestine. The stools are sometimes yellow when passed, but become green by exposure to the air or from chemical reaction due to admixture of the urine.

In consequence of the diarrhœa and impaired nutrition, the patient becomes pale, his muscles soft and flabby, and soon there is evident loss of flesh. If there is fretfulness in the beginning of the sickness, it ceases with the increasing weakness, and the patient lies quiet, having an exhausted appearance. As the catarrh continues in the graver cases, the features become pinched and wrinkled; the hollowness of the cheeks and sunken state of the eyes are in striking contrast with the appearance presented before the inflammation began. So feeble is the muscular power in advanced cases of a severe attack, that the muscles which close the eyelids and the lips lose in great part their power of contracting, and the eyes and mouth remain open during sleep. The pulse is quickened, and temperature elevated according to the extent and intensity of the inflammation; but when the vital powers become reduced, the temperature of the body, previously elevated, often falls considerably below the healthy standard. As death approaches, the pulse gradually becomes more frequent and feeble, and the extremities, sometimes for hours before life is extinct, have a corpse-like pallor and coldness. In severe forms of the catarrh, accompanied by frequent watery stools, the functional activity of the skin and kidneys is impaired, so that the skin is dry, and the urine is passed in small quantities and infrequently. This impairment of the functions of the skin and kidneys is notably present in the catarrh of the summer season. In advanced cases boils often appear upon the forehead and scalp. They sometimes extend to the fibrous tissue covering the skull, and when they heal, leave scars which may be permanent. Acting as external irritants, they sometimes appear to be conservative, as they occur at the time when there is danger of the brain complication, presently to be alluded to. Inflammation of the skin upon the buttocks, especially of the part covered by the diaper (*erythema intertrigo*), is also common, being produced by the irritating character of the discharges. It is sometimes accompanied by ulcerations, and it often increases the suffering of the infant, who is observed to fret when the parts are wet with the urine.

In severe cases, which, continuing unchecked by treatment, have reached a stage of dangerous prostration, certain peculiar complications are apt to arise, due to weakness of the heart and

consequent feeble circulation of blood. The channels for blood within the skull (*cranial sinuses*), the capillaries and veins in the lowermost portions of the brain, and the membranes which enclose it (*meninges*), become congested with dark blood, and the fluid portion of the blood (called *serum*) transudes more especially from the feebly supported vessels. This liquid, which, as I have many times observed, is a pure serum, lies over the external surface of the brain, lifting up the fibrous envelope, called the *dura mater*. This passive congestion and outpouring of serum are favored by the wasting of the brain, which occurs to a limited extent as a part of the general emaciation. This condition, which is in reality a species of dropsy following the congestion, has long been known under the title of *spurious hydrocephalus*, or *hydrocephaloid disease*. It is a common complication of the summer complaint of infants in the cities, when it is approaching a fatal termination, and it produces symptoms which mask those of the primary malady, and often render correct understanding of the disease difficult.

Another common complication of severe and protracted inflammatory diarrhœa is also due to the diminished contractile power of the heart, and the consequent feeble circulation of blood. Infants who have reached a certain degree of emaciation and feebleness are observed to have an occasional dry cough. This is due to the settling of blood in the veins and capillaries in the lower portions of the lungs. This congestion continuing, by and by ends in a form of pneumonia or inflammation of the lungs ; it is one of the most frequent conditions observed in infants who have died of this disease after weeks of wasting and loss of strength.

The intestinal catarrh of infants may be arrested at any stage. If it has continued only a brief period, convalescence is speedy, if the inflammatory action is fully controlled ; but if the case have been of long continuance, recovery is always slow, and liable to fluctuations.

In a case about to terminate fatally the infant sometimes becomes more fretful ; it turns peevishly from playthings, rolls its head, or the head has an unsteady movement, and often the stomach becomes more irritable. The experienced physician rightly interprets these symptoms as the forerunner of brain trouble. In other instances the infant is too weak to exhibit its restlessness, and lies quiet. When death is near, the infant becomes more drowsy, its limbs cool, and it refuses to nurse, or, if bottle-fed, it takes nutriment apparently without relish. The pupils of the eyes are contracted, and do not change in size under the influence of light ; the eyes are bleared and a mattery secre-

tion occasionally collects between the lids ; the stools are less frequent than at first, and vomiting, if previously present, ceases. Death occurs quietly.

Treatment.—Intestinal inflammation requires somewhat different treatment, according to its cause and the condition of the infant. It will often, on account of thirst, take a larger amount of nutriment than it actually requires, and will overload its stomach and overtax its digestion. This should not be allowed. It should take no more nutriment than it requires in its healthy state ; and if it crave more liquid to quench thirst, it may take gum-water or thin barley-water.

Cases contracted by exposure to cold require warm and slightly irritating applications over the abdomen, as a flaxseed meal poultice, with one-sixteenth part of mustard flour added, or a flaxseed meal poultice, with camphorated oil smeared on the side which is to be next to the skin. After the acute stage has passed, more nutritious diet should be allowed. Often the alcoholic stimulants in barley-water, and sometimes the animal broths, are needed in this stage of the malady. Anything calculated to weaken the infant should be carefully avoided.

Since a chief cause of intestinal catarrh in infancy, especially in cities, is the use of food which is with difficulty digested, and which, therefore, becomes irritating to the intestines, it is of the first importance, in the treatment of most cases which are not referable to exposure to cold, to give particular attention not only to the nature of the food, but to the mode of its preparation and the quantity given. To the young infant no food is obviously so suitable as the breast milk, and one under the age of ten months, especially if the weather be warm, and it remain in the city, should, if possible, have a wet-nurse.

Frequently the bottle-fed city infant, who has contracted intestinal catarrh during the summer months, in consequence of improper feeding and the depressing effects of the hot weather, begins at once to improve when provided with a wet-nurse, so that it is often really surprising to observe, as a consequence, progressive and complete restoration to health from a state of great emaciation and feebleness.

In certain exceptional instances the breast milk, either of the mother or wet-nurse, does not agree with the infant, and its use aggravates the intestinal malady. In the country, or during the cool months in the city, weaning may be proper ; but in the summer months, in the city, weaning is a very injudicious, if not fatal, measure ; and if the breast milk which the infant receives do not agree with it, and there is reason to think that, on the con-

trary, it aggravates the intestinal malady, another wet-nurse should at once be employed. The city infant should never be weaned between the months of May and October. If an infant under the age of ten or twelve months have from necessity been deprived of breast milk, and have acquired inflammatory diarrhœa from the bottle-feeding, that kind of artificial food should be provided which most nearly resembles human milk. Facts relating to this subject will be found in the section which relates to **Indigestion.** (See page 495.)

Attention to the diet of infants affected with intestinal inflammation is obviously of the utmost importance; but one of the chief causes of this malady, especially of the great summer epidemic of the cities, is, as we have seen, atmospheric. This requires attention on the part of the physician to the state of the air which the infant breathes. In cool weather the atmosphere is more pure than in the hot months, since it contains less of those noxious gases which arise from decaying animal and vegetable substances. In those months, therefore, in which, from the low temperature of the atmosphere, decomposition of organic matter nearly or quite ceases, the removal of the patient to a more salubrious locality is not so imperatively required. But in the summer season one of the most important conditions of the successful treatment of this and other diarrhœal maladies is the removal of the infant from an impure to a pure atmosphere; from a crowded tenement-house to an airy residence; from the city to the country. Many instances occur every summer, in the city of New York, in which infants with intestinal inflammation are removed to the country, with features shrunken and haggard, with limbs wasted and skin lying in folds, too weak to raise or, at least, hold their heads from the pillow, yet who return in the late autumn with the vigor, rotundity and cheerfulness of health.

Occasionally it is proper to commence the medicinal treatment by the employment of a gentle purgative, especially when there is reason to suppose that the food has been indigestible and irritating; for this purpose a half-teaspoonful of castor oil will suffice. But intestinal inflammation due to catching cold does not, in general, require this preliminary treatment, nor do cases occurring in the summer epidemic of cities. In these summer epidemics of intestinal inflammation, the diarrhœa, moderate in amount perhaps, has ordinarily continued for a time when the physician is called, and no irritating substance remains in the intestine excepting the acid, which is often formed in abundance in this disease from fermentative changes in the contents of the intestine, and which we are able to remove without purgation.

It is very important that the food of infants affected with this malady should be bland and unirritating. The breast milk is preferable to all other food, when it can be obtained in sufficient quantity, for children under the age of twelve or fourteen months. When it cannot be obtained, or is obtained in insufficient quantity, the infant, prior to the close of the first year, should have the best cow's or goat's milk, preferably the upper half or third, taken after the milk has stood two hours in a cool place, to which barley-flour, well boiled in water, Ridge's Food, Liebig's Food, or one of the other well-known and recommended dietetic preparations has been added.

Acid vomiting, and acid stools, so common in this malady, show the need of great care in the selection and preparation of the food. The food should be tested by litmus-paper,* and if acid, it should be rendered alkaline by the addition of a small amount of lime-water, bicarbonate of potassium, or bicarbonate of sodium. If, with these precautions as regards the diet, there is still acid vomiting or acid stools, the quantity of these alkalies must be increased.

In addition to the alkali, which should be employed or withheld according to the exigencies of the case, opium is employed by most practitioners, and properly, in the treatment of this malady. In the infant, as in the adult, its curative effect upon intestinal inflammation is unmistakable.

For a young infant paregoric is the best form of opiate. The dose is from three to five drops for the age of one month ; ten to twelve drops for the age of six months, repeated after three hours or longer, according to the state of the patient. For infants over the age of six months the stronger preparations of opium are more frequently used. The common tincture of opium, or laudanum, or the deodorized tincture, may be given in doses of one to two drops to a child of one year. Dover's powder, also, is a useful opiate for this malady when given in doses of three-fourths of a grain to a child of one year.

The cases are few in which the *judicious* use of opiates involves

---

[* Litmus-paper, here and elsewhere referred to, is made by dipping unglazed white paper into tincture of litmus, and then dried. When this paper is brought in contact with fluids which are acid (or sour), its color is changed to red. A similar paper, made by coloring it with tincture of litmus reddened with a minute quantity of sulphuric acid, is used as a test for alkalies, since these have the power to change its red color back again to blue.

Litmus-paper may be purchased of any apothecary, and should be kept in a clean, closely corked and large-mouthed vial, since prolonged exposure to the air will turn it from blue to red.—Ed.]

danger, but they should be used *very cautiously* if brain symptoms are present, and always, if possible, with the advice of a physician. Sometimes, in the commencement of intestinal inflammation, if there is considerable feverishness, the patient may be drowsy and have sudden twitching of the muscles, showing that there is danger of convulsions. Under such circumstances the opium should be administered in small doses, or its use postponed. Also, in advanced stages of the disease, when there is a tendency to drowsiness from the feeble circulation of blood through the brain and, often, escape of the serum or watery portion of the blood under and between the coverings of the brain, opium should be cautiously employed, as it might tend to produce that fatal stupor in which severe cases are apt to terminate. With such precautions this indispensable remedy will exert a decided controlling effect on the disease.

Astringents are required when the stools are thin and too frequent, and these may be employed in combination with the opiate. Those which heretofore have been chiefly used by doctors are the vegetable astringents, as : catechu, kino, krameria, and tannic and gallic acids ; and also, particularly in the chronic cases, the mineral astringents, such as acetate of lead and nitrate of silver, in small doses. But I think that I express the common belief of New York physicians in stating that better than all of these, for the various indications, as an anti-emetic, astringent, and antiseptic, is the subnitrate of bismuth. This substance has indeed long been employed in the diarrhœal maladies of infancy, but in doses much too small. Its effects are believed to be entirely, or almost entirely, local, namely, upon the inner surface of the stomach and intestine. It is but sparingly absorbed. It is stated by some not to be absorbed at all ; but an intelligent physician has stated to me that he has sometimes observed a peculiar odor of the breath of children who are taking this medicine and I have, in a few instances, observed the same.* It undergoes or effects some chemical change in the stomach, becoming, probably, the bismuth sulphide, for it becomes black in this organ, and it gives a dark tinge and more consistence to the stools.

The following formula, calculated for infants aged one year, has been used with the best results in my private practice, and in institutions with which I have an official connection :

[* The odor here referred to is now thought to indicate that the bismuth contains arsenic as an impurity. When taken in this way the arsenic imparts an odor of garlic to the breath.—ED.]

Tincture of opium	16 drops.
Subnitrate of bismuth	2 drachms.
Simple syrup	½ ounce.
Chalk mixture	1½ ounce.

Shake the bottle, and give one teaspoonful every three hours.

An infant of six months can take one-half this dose, and one of three or four months, one-fourth or one-third of the dose.

Instead of the above, I have sometimes prescribed essentially the same medicines in powder, namely :

Compound powder of chalk and opium	40 grains.
Subnitrate of bismuth	2 drachms.

Mix and divide into fifteen powders and give one powder every three hours to an infant one year of age.

An infant of six months can take half the above dose, or, one of three or four months, one-fourth or one-third the dose. In all those cases in which the evacuations consist chiefly of mucus, or mucus and blood, from the predominance of inflammation of the large intestine, and in all recent cases in which the evacuations are scanty, and there is considerable fever, one of the best remedies is laudanum in combination with castor oil, as in the following prescription, which is similar to that of Dr. West, of England :

Tincture of opium (*laudanum*)	16 drops.
Powdered gum-arabic	1 drachm.
Powdered white sugar	1 drachm.
Castor oil	1 to 2 drachms.
Cinnamon-water	2 ounces.*

The dose is one teaspoonful every three hours to an infant of one year.

When the disease is chronic, and the vital powers begin to fail, as indicated by paleness, more or less emaciation, and loss of strength, the following is the best tonic mixture with which I am acquainted. While it aids in restraining the diarrhœa, it also increases the appetite and strength. It should not be prescribed until the inflammation has assumed a less acute or chronic character.

Tincture of columbo	3 drachms.
Solution of nitrate of iron	27 drops.
Simple syrup	3 ounces.

The dose is one teaspoonful every four hours to an infant of one year.

[* It is necessary to make, first, an emulsion by rubbing in an earthenware mortar the castor oil with the powdered gum-arabic and sugar, and when they are *well* mixed add next the cinnamon-water, and then the tincture of opium, and rub them all thoroughly together with the pestle.—Ed.]

In most cases of intestinal inflammation, occurring in infancy, alcoholic stimulants are useful. They are especially useful in cases which occur under the depressing influence of warm weather, and in all protracted cases, whatever the cause. Bourbon whiskey or brandy is the best of these stimulants. I have usually prescribed three or four drops to an infant one month of age, and an additional drop or two drops for each succeeding month.

Constipation.

Constipation occurs much less frequently in infancy and childhood than in adult life. Some young children, when in health, do not have more than one stool daily, while the majority have two or three. If the evacuation occur only every second or third day, and is accompanied by straining, constipation is present. The constipated stools are usually firm and dry, and not infrequently they have a light color. The abdomen is apt to be distended with gas, but there are cases in which it is soft and flattened. In aggravated cases, hard masses are sometimes felt through the abdominal walls.

The symptoms of constipation are poor appetite, restlessness, occasional vomiting, colicky pain in the bowels, headache, sometimes fever, foul tongue, disturbed sleep, nervous irritability, so that convulsions are apt to occur from slight exciting causes. These symptoms may be mild and some of them absent in light cases, while they occur in a decided manner in grave cases. In severe and protracted constipation, the hard fæces in the lower part of the intestine often cause severe straining, so that the lower inch or half inch of the intestine may protrude; but this prolapse of the gut, which is readily replaced by pressure upon it, is not so likely to occur from constipation as from diarrhœa. Harm to the general health in habitual constipation results from the fact that the stools contain noxious, even poisonous products, and that when detained in the intestines these products are, to a certain extent, absorbed. Hence the foul breath, coated tongue, and languor which attend the constipated habit.

The causes of habitual constipation are various, among which the following may be enumerated: too scanty a secretion, in other words a torpid state of the organs which furnish the liquids which mix with the food, as the liver, pancreas, or sweet-bread, and the numerous glands with which the surface of the intestine is studded; the use of milk too rich in the cheesy substance; the use of food containing too much starch; insufficient drink, for

the moderate use of water aids greatly in maintaining proper consistence of the stools and promoting the evacuation ; and finally, too feeble action of the muscular fibres, by which the food is propelled along the intestines. This torpid state of the muscular fibres, both in the coats of the intestines and in the large muscles of the abdominal walls, which aid in expelling the stools, may be due to some unknown peculiarity in the constitution of the individual, but is, in other instances, the result of disease. Thus, diseases of the brain and spinal cord are apt to produce a paralytic state of the muscular fibres through deprivation of nervous agency, so that constipation is one of their most common symptoms. The most obstinate and dangerous cases of constipation result from mechanical obstacles, as foreign substances, like seeds and kernels of fruit ; loops of the intestines which have grown to each other by previous inflammation (peritonitis), and displacement of intestine at a certain point (intussusception, hernia). I have met cases from all these causes.

Treatment.—Constipation from a mechanical cause is acute and painful, so that it demands the immediate attention and care of the physician. In habitual constipation, any error of diet should be rectified. Raw or cooked fruits, coarse oat or corn-meal prepared in a mush, and thin gruels, have a laxative effect. To overcome the constipation a mild laxative, like the syrup of senna, is useful, but better than this is a clyster of one-third or one-half teacupful of cold water. In habitual constipation, benefit will result by allowing the child to drink cold water somewhat more freely than heretofore. I have also obtained good results by directing the mother or nurse to knead the abdominal surface several times daily with the fingers. This stimulates the muscular action of the intestines. Occasionally we meet cases in which, from long neglect, hard masses of fæcal matter are lodged in the lower part of the intestine, and if these are not removed by the clyster they should be broken up by introducing the finger or the handle of a teaspoon.

[A common domestic remedy consists of a piece of ordinary yellow laundry-soap of the thickness of a pencil, and from one to one and a half inch long, which is pushed gently into the bowel and left to take care of itself. A soap *suppository*, as it is called, will ordinarily cause a movement in a short time, and, if used with care, this treatment can be repeated daily.

Castor-oil and rhubarb are not always to be recommended in this condition, although they have been so commonly used ; the reasons for this will be given in the chapter relating to the Remedies in Common Use. See Index of Volume II.—Ed.]

Intestinal Worms.

So far as now ascertained, about fifty animal parasites make their abode in man. Probably others will yet be discovered in distant and uncivilized countries, for the forms of animal life vary in different climates and regions. Of those which occupy the intestinal canal, the following are of chief interest, on account of their frequency and the symptoms to which they give rise, namely, the long *roundworm*, the *thread worm*, three species of *tape-worm*, and the *whip worm*. These worms have received such popular names from their resemblance in shape to the objects by which they are designated.

The *round worm* has a dingy reddish or yellowish red color, and a cylindrical form tapering toward both extremities, from the point of its greatest diameter, which is a little behind the middle. The dead worm is paler than the living one. The females are more numerous than the males, and their size is also greater. The shape of this worm is like that of the common earth worm, from which it derives the name *lumbricus*, but it is somewhat more pointed, and its color a paler red. The location of the round worm is the small intestine, where it is rapidly developed from the egg.

The round worm, more than all other intestinal worms, is inclined to wander away from its usual abiding-place, producing symptoms of more or less gravity referable to the part over which it passes. It occasionally enters the stomach, from which it is vomited, or it ascends the œsophagus into the throat, from which it is expelled by the efforts of the individual. Rarely it has entered the windpipe from the œsophagus, producing suffocation. This worm is indeed so strong and active, that there is no recess or fold connected with the intestinal cavity which it has not entered, and, becoming wedged in narrow passages, as the bile-duct, pancreatic duct, or that narrow cul-de-sac, the *appendix*

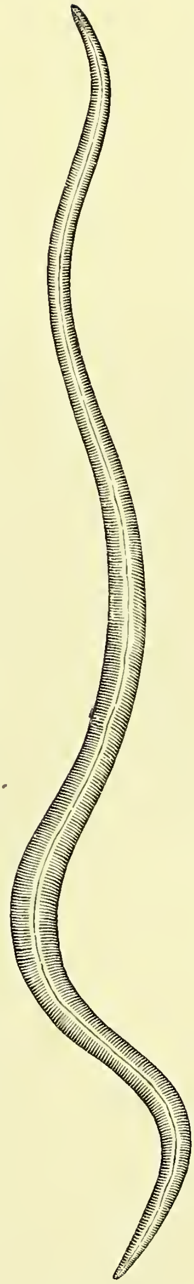


FIGURE 217.—A female roundworm (*ascaris lumbricoides*), natural size.

vermiformis (worm-like appendix), in which small foreign substances are apt to lodge, it has sometimes caused ulceration and death.

The number of these worms found in the intestines is very variable. There may be only one, or the number may be incredibly large. When a considerable number are present, they sometimes form masses by their intertwining, which are difficult of expulsion, and which, therefore, involve great danger.

The *thread worm,* so called from its resemblance to pieces of ordinary white sewing-thread, is also frequent in childhood, and not infrequent in the adult. Its length is from one-sixth to one-half of an inch, the male being shorter than its mate. The chosen residence of this worm is the large intestine, and the largest number of them are found in the two extremities of this division of the intestinal tract, namely, in the upper end or head of the colon, which lies in the right lower portion of the abdominal cavity, and in the lower end or rectum, which lies in the pelvis. Nevertheless, thread worms are developed so rapidly from eggs swallowed in food or drink, that they may attain nearly or quite their full growth while still in the small intestine, and they therefore sometimes occur of full size and activity in this division of the intestinal tract. Thread worms are the most numerous of all the intestinal worms which are visible to the naked eye.

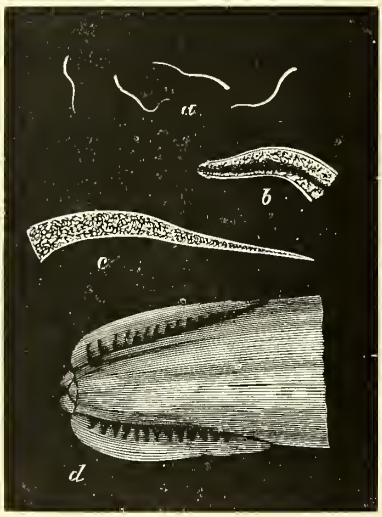


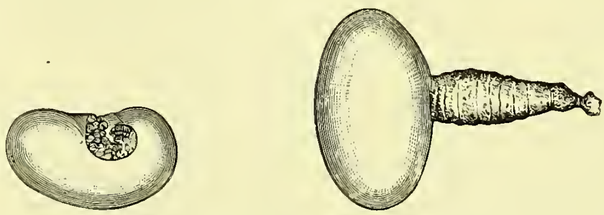
FIGURE 218.—Thread worm (Oxyuris vermicularis): *a*, Natural size; *b*, head magnified; *c*, tail magnified; *d*, head more magnified.

The term *tape-worm* is applied to several species of the *Tœnia,* and to at least two species of the *Bothriocephalus latus;* but all of these, except four, namely, the *Tœnia solium, Tœnia saginata,* or, as it is sometimes termed, *Tœnia medio-canellata, Tœnia elliptica,* or *Tœnia cucumerina,* and the *Bothriocephalus latus,* are rare in Europe and North America.

The tape-worm is a hermaphrodite, each segment containing the two sexual organs. The head is small, about the size of a pin's head, and segment after segment is produced by a budding process from the head. The segments are attached to each other at their extremities, and each segment, as it becomes further and

further removed from the head by the formation of new intervening segments at the upper end of the chain, becomes also larger and more matured. The older segments, having attained their full growth, are detached. A separation of the chain of segments at any point does not compromise the life of the parasite. If only the head remains uninjured, segmentation continues from it, and, in time, the former number of segments and former length of the chain are restored. This worm resides in the small intestine, extending downward from the point where the head is attached.

One of the two tape-worms which are most commonly met in this country, the *Tœnia solium,* is developed from an embryo, known as the *Cysticercus cellulosœ,* which occurs in the muscles of swine. This cysticercus is a little bladder-like body, called a vesicle, about the size of a pea or small bean, having a delicate cell-wall, and is nearly spherical, except as its shape is changed by compression between the muscular fibres. At one point of the



A B

FIGURE 219.—Cisticercus cellulosæ, magnified: A, Natural position; B, head and neck protruded.

cell-wall is a depression, attached to the inner surface of which, and therefore lying within the cyst, is a whitish, pear-shaped solid body, which is the head, and is identical in shape and appearance with the head of the *Tœnia.* Many experiments have shown the close relationship of the *Cysticercus* and *Tœnia solium,* that they are forms of existence of the same parasite. Segments of this tape-worm have been repeatedly fed to swine, and the cysticercus has been produced in their muscles, though in what way the little egg or embryo passes from the hog's stomach to its muscles is not yet known. On the other hand, pork containing the cysticercus has been fed to criminals who were soon to be executed, and after their death the *Tœnia* was found in their intestines. It is now evident that this parasite occurs only in those who eat swine's flesh, either raw or but slightly cooked, as in sausages. The head of this species of tape-worm is about the size of a small pin's head. At its top is a conical protuberance, upon which is a corona of hooklets arranged in two circles: the hooklets of the outer circle being

smaller than those of the inner. Back of this circle of hooklets are four sucking-disks which the worm is able to protrude and move freely. When protruded, they appear as small tubercles, with slender pedicles or stalks. The neck, which is slender, and about one inch in length, shows no marking from commencing segmentation, and it is succeeded by very small and delicate seg-

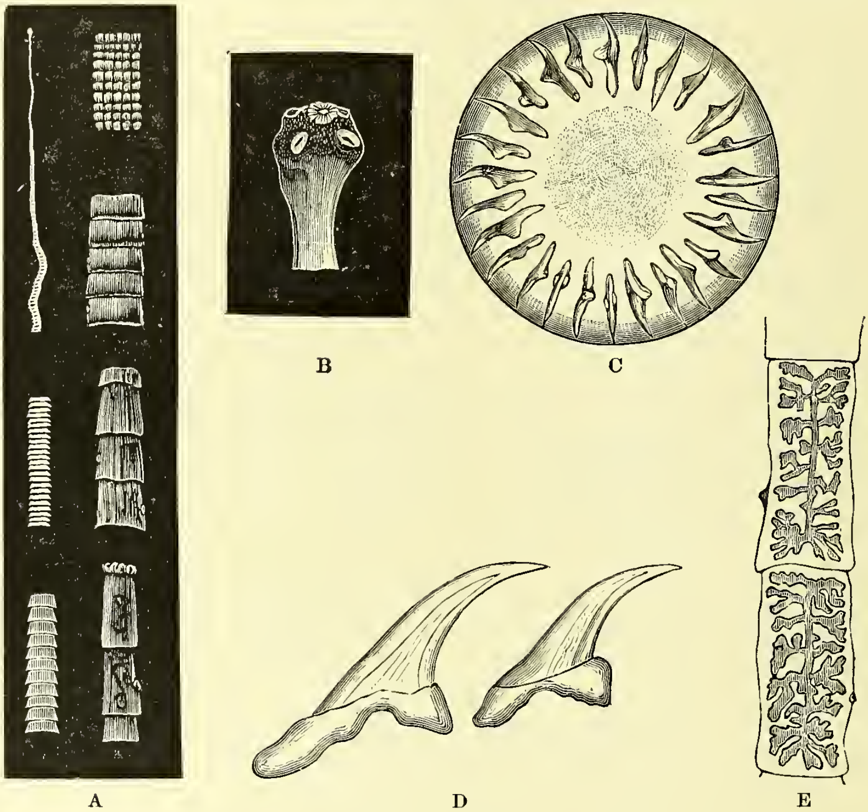


FIGURE 220.—Tape-worm (*Tænia solium*): A, Portions of the worm of natural size; B, head, magnified; C, circlet of hooklets which surround one of the suckers; D, separate hooks, more largely magnified; E, full-grown joints of a tape-worm, magnified.

ments, which gradually enlarge as the distance from the head increases.

The *Tænia saginata*, designated also *T. medio-canellata*, resembles closely, in its general appearance, the species just described, but its head is larger and its segments larger, thicker, and stronger than those of the tænia solium. When fully matured, it measures eighteen inches. The diameter of the head is nearly one line ($\frac{1}{12}$ inch). It is furnished with four strong sucking-disks, but it lacks

the circle of hooks, instead of which it possesses a small frontal sucking-disk. The embryo of this parasite occurs chiefly in the

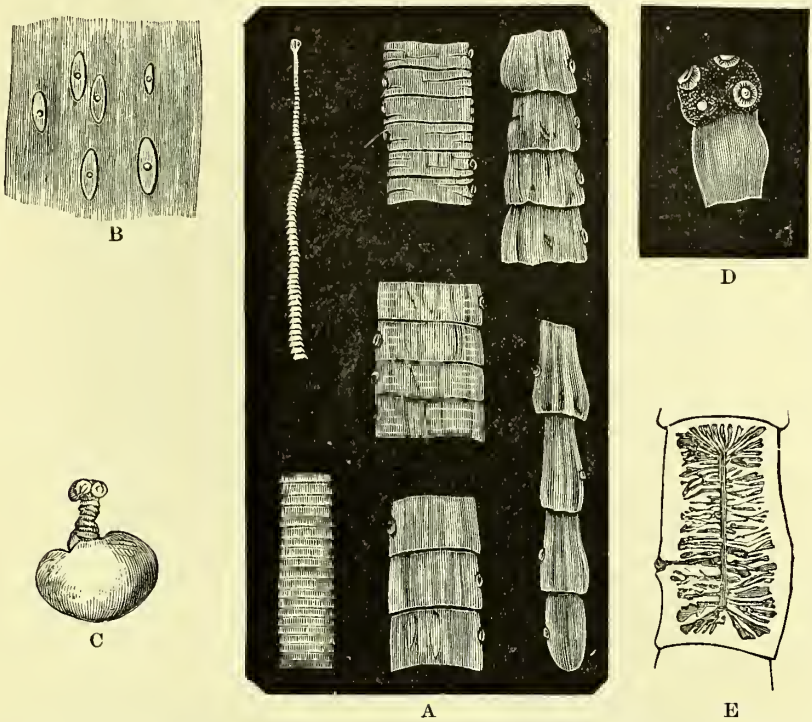


FIGURE 221.—*Tænia saginata:* A, Portions of a worm of natural size; B, a number of the *Cysticerci* from which this tape-worm is developed, of nearly natural size and situated in the fibres of a muscle; C, a magnified *Cysticercus* with its head and neck protruded; D, head of the worm, magnified; E, fully grown joint of the worm.

muscles of ruminating animals, as the ox, sheep, goat, etc., and therefore its presence in the intestines of man is attributable to the use of the flesh of these animals, either slightly cooked or raw.

The *Tænia elliptica*, or *cucumerina*, is more delicate than the above species of tape-worm, measuring, when fully grown, from ten to eleven inches in length. Upon its head is a rostellum, or beak, which the worm is able to thrust forward, and on which are about sixty hooklets irregularly arranged. This tape-worm, the small delicate segments of which have a reddish-white color, inhabits the small intestines of the dog and cat, and many children in different localities have been affected with it.

The *Bothriocephalus latus*, is the largest of the tape-worms, attaining the length of fifteen to twenty-four feet. It is one of the most important of the intestinal parasites. The head has an

almond-shape, or the shape of an elongated and somewhat flattened globe, its length being about one line (one-twelfth of an inch), and its diameter from one-third to one-half a line. Those segments which are still growing have a breadth three or four times greater than their length, while the matured segments are nearly square.

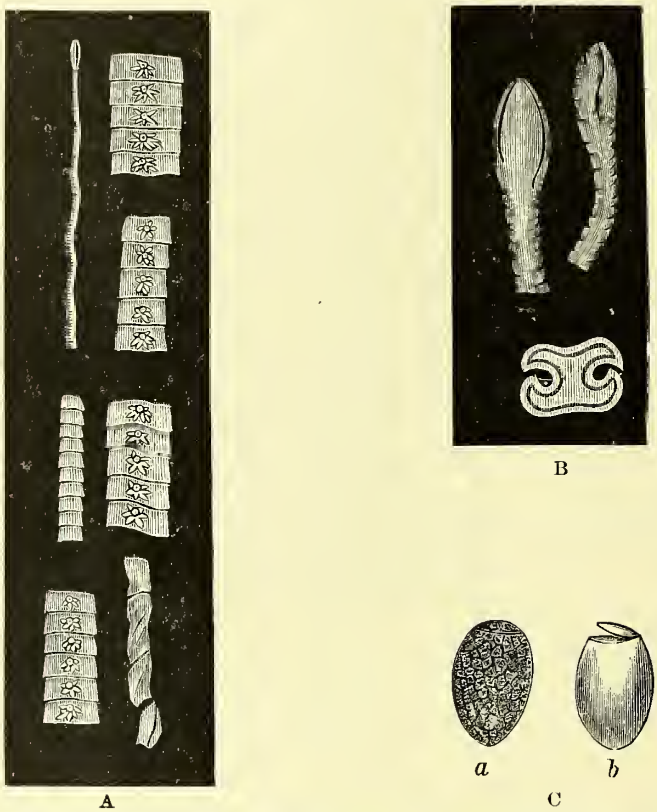


FIGURE 222.—*Bothriocephalus latus:* A, portions of the worm of natural size; B, head of the worm, magnified; C, eggs of the worm, magnified; *a*, an entire egg with its yolk; *b*, empty shell.

The egg is oval, with a thin shell. It is believed that the embryo enters a mollusk or fish, in the muscles of which it is developed. It is, therefore, received into the stomach of man in some form of marine food. This parasite is rare in this country, and in Europe it is chiefly met in countries bordering on the inland lakes and seas. It occurs also in dogs which eat fish.

The *whip worm*, or *Trichocephalus dispar*, is comparatively unimportant, since it is not known whether it materially impairs the health or produces symptoms. It inhabits the large intestine.

Intestinal worms are rare in infants under the age of sixteen months, since milk is the chief diet of such. The roundworm and threadworm are common after the period of infancy, during the whole period of childhood, and are not unusual in the period of youth. The tape-worm is rare under the age of five years, but cases now and then occur. The liability to this parasite depends entirely on the diet, whatever may be the age. A remarkable case of tape-worm was reported in the *Gazette Médicale* of Paris, in 1837. M. Muller was called to treat an infant of five days, for slight constipation, and in the stool one and a half feet of tape-worm were discovered. A similar case was treated by Prof. Skene, of Brooklyn, in 1871.

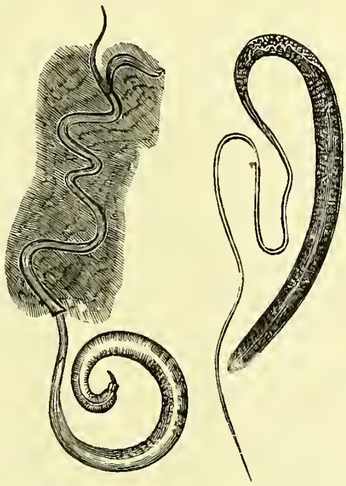


FIGURE 223.—Male and female *Trichocephalus dispar*, magnified.

Causes.—It is obvious that intestinal worms are developed from the eggs, or embryos, as the case may be. The eggs of the round worm have been found by Mosler in drinking-water;* but it is probable that in most instances they are introduced into the system in fruits and vegetables which are eaten raw.

The eggs of the thread worm are received from some one who is affected with the disease. Both Zenker and Heller state that they have frequently discovered eggs of this worm around the nails of those who were troubled with this parasite, a fact readily explained from the itching of the anus which they cause. We can understand, also, why this worm is so common in degraded families. Certain conditions of the intestinal surface favor the occurrence of worms. Thus, the altered intestinal secretions in typhoid fever favor the development of the round worm.

Symptoms.—The symptoms caused by the round worm are in part constitutional and in part local. Those of a constitutional character are the following:

Features at one time flushed, at another pallid, and sometimes of a leaden hue; thirst, nausea, or even occasional vomiting; appetite diminished or augmented, or variable; breath foul; red and projecting points on the tongue; pulse quickened and irregular. Quickening of pulse is one of the most common symptoms of these worms, with more or less elevation of bodily temperature.

* Virchow's Archives, 1860.

In severe cases symptoms referable to the nervous system are sometimes present, such as large pupils, twitching of the muscles, convulsions, drowsiness, headache, neuralgic pains, delirium. Rarely, chorea or St. Vitus's dance, has been known to result. In the *American Journal of Medical Science,* for July, 1869, Dr. Leedum relates the case of a boy of seven years who had night-blindness, due to the presence of a large number of round worms in the intestines. By the employment of pink-root these were expelled, and the blindness ceased. Grinding the teeth in sleep and picking the nostrils are symptoms to which families attach much value; but observations show that, though they may be due to worms, they more frequently have another cause. Colicky pains, chiefly in the region of the navel, irregular stools, sometimes tinged with blood, and flatulence, are occasional symptoms. If several round worms are present, the physician is able to discover their eggs in the stools by means of a microscope magnifying one hundred and fifty diameters.

The most dangerous symptoms arise from the fondness which the worm exhibits of crawling through narrow passages. Thus the presence of the worm may produce a crawling sensation in the œsophagus, or a feeling of constriction in this tube, or in the upper part of the throat, and if it have reached the opening of the larynx, it causes a violent cough, vomiting, and perhaps even suffocation. If, turning backward, it enter the Eustachian tube, which leads from the throat to the ear, it causes earache, and sometimes convulsions.

The intestinal catarrh which the worm produces is ordinarily mild. Occasionally very dangerous and painful constipation results from the accumulation of these parasites in a mass, or ball too large to be expelled, unless with much delay and suffering.

A marked example of this occurred in a family of my acquaintance, which, at the time, resided in the interior of this State. A little girl three or four years of age was suddenly affected with obstinate constipation. The physicians prescribed active purgatives, calomel among other things, and finally croton oil. Various injections were likewise used without relief. There was great pain with swelling of the abdomen, and death seemed inevitable, when, after the lapse of several days, a free evacuation occurred, and in the stool was a mass of firmly intertwined worms.

The symptoms produced by *thread worms* are different from those of the round worm. It does not cause the fever, disturbed digestion, colicky pains, or such dangerous nervous or local symptoms as the other parasite causes. Nor does it endanger life by crawling into unusual situations. In one recent case I could de-

tect no other cause of St. Vitus's dance than their presence, and convulsions have been attributed to them ; but such a result is exceptional, if, indeed, the cause was rightly assigned. Although the upper end of the large intestine (the *cæcum*) is the chosen abode of the worm, it is not certain that it produces *any* symptom in this situation. The symptom which renders this parasite very annoying is itching of the anus, due to movements of the worms in the lower part of the intestine. A small number of them may cause little inconvenience, but when a considerable number are present, it is sometimes difficult for a patient to remain quiet, on account of this symptom. The itching is usually greatest in the early evening, when the child is warm in bed. The irresistible inclination to rub the parts occasionally leads to the practice of self-pollution in girls as well as boys. The itching may be nearly or quite absent during the day, but returns so regularly at night as to resemble and be mistaken for a nervous affection. M. Cruveilhier, one of the most eminent of French physicians, confessed that he had made this mistake. In the female child this worm occasionally passes from the rectum to the vulva, irritating the surface of the latter and producing a leucorrhœal discharge, or *whites.*

In many instances tape-worms exist in children as well as in adults who thrive and present no symptoms, but in other instances there is more or less disturbance of the digestive functions, with an uncomfortable sensation—sometimes a cramp-like pain in the belly. This symptom is most frequently noticed after fasting, or after the use of certain kinds of food, and is diminished by a full meal. A feeling of hunger and of faintness is also common according to authorities, but I have not particularly remarked this in children. Irregular action of the bowels, vomiting and various nervous symptoms, as itching of the nostrils and anus, headache, ringing in the ears, "heart-burn," numbness, deafness, blindness, etc., have been, with more or less correctness, attributed to the tape-worm. Certainly such symptoms occasionally arise from this cause, for they cease on the expulsion of the worm.

Treatment.—Much injury has been done to children by the use of medicines designed to expel worms, occasionally employed by physicians, but oftener by parents before the physician is called. Drugs of this kind are usually irritants, and in certain other diseases the prominent symptoms in which resemble those caused by the presence of worms, there is already an irritated, if not an inflamed state of the intestinal surface. Administered under such circumstances, such medicines obviously do harm, and in all acute diseases in which they are not required, their employment is to be

regretted, even if their action is harmless, since it consumes time which is very precious.

It is thus that many lives are lost by the use of vermifuge nostrums, which are extensively advertised, and which command a ready sale, inasmuch as belief in the presence of worms as a frequent cause of disease pervades nearly every community. A safe rule followed by certain physicians (and it would be much better if it were general) is not to give vermifuges, unless, after careful inspection of the stools for one or more weeks, the parasite is discovered; since, if worms are present, one or more will occasionally be expelled, or, if it be a tape-worm, the segments will be noticed in the evacuations. Physicians can also determine the presence and character of intestinal worms in a patient thus affected by observing the eggs in the stools with a microscope, for the eggs of each species have a peculiar form, and are passed in countless numbers. In doubtful cases, in which the symptoms closely resemble those of worms, a purgative dose of calomel, or calomel and rhubarb (five grains of each), may be employed. It will generally bring away one or more round worms, or a mass of thread worms, if either of these species of parasites is present. This purgative may be safely employed if there is no previous diarrhœa or debility; and if the result of its employment is negative, it is pretty certain that neither of these worms is present.

A large number of drugs have had a reputation for the expulsion of the round worm. *Santonin,* the active principle of the European worm-seed, is one of the best, and is much employed in this country and in Europe. It is nearly tasteless, and may be given in powder, spread on bread with butter. It is kept in the shops in lozenges, with or without calomel. It has the advantage of easy administration, and is destructive to both the thread and round worms. In this country santonin is usually administered in one- to three-grain doses two or three times daily, with an occasional purgative, which aids in the expulsion of the worm and its eggs. In overdoses, it sometimes causes vomiting, diarrhœa, bloody urine, and altered vision, so that objects seem yellow; but in medicinal doses it has no ill effect.

For many years the worm-remedy most employed in this country was the pink-root, the root of the *Spigelia marylandica,* a native plant. It was not only prescribed by physicians, but employed by families as a domestic remedy. It is apt to cause, if the dose be large, brain symptoms, such as dizziness, dimness of sight, spasm of the muscles of the face, stupor, and convulsions. These effects less frequently occur if the pink-root is given with a purgative, like senna. Half an ounce of pink-root, mixed with an equal

quantity of senna-leaves, is soaked for two hours in a pint of boiling water, and then strained. For a child two or three years old the dose is one to two tablespoonfuls. So popular has this remedy been in this country that probably a majority of the native-born adults of the States recollect the nauseating doses of pink-root administered by anxious parents. Pharmacy now provides us with the same medicine in a more convenient form--that of a fluid extract. The fluid extract of senna and that of spigelia, mixed in equal quantity, may be given in teaspoonful doses to a child of five years. There is a fluid extract of pink-root and senna found in the drug-stores, to each ounce of which eight grains of santonin may be added. This is probably the best remedy for the round worm in complicated cases, when given in teaspoonful doses.

Oil of worm-seed is also a good vermifuge for the round worm. It is efficient, and at the same time one of the safest, especially when the inner surface of the intestine is inflamed. To a child of three years, five drops may be given three times daily, dropped on sugar. It often has a good effect on those forms of intestinal irritation or catarrh which resemble the condition produced by worms. Turpentine is also an efficient antidote for the round worm. It may be given in the same dose and manner as the oil of worm-seed. It is especially useful in long-continued intestinal catarrh, attended by an increased secretion—a state in which worms are apt to occur.

It is useless to enumerate the many vermifuges which have been extolled from time to time. Those mentioned above are the safest, least nauseous, and they will rarely lead to disappointment.

One other antidote for the round worm should be mentioned, as it has been much used and is efficient, namely, the bristles which cover the pods of the cowage or *Mucuna pruriens,* a tropical plant. The pods are dipped in plain syrup of the ordinary consistence and the bristles are scraped off with the syrup. When enough of the medicine is added to the syrup to make it of the consistency of honey, it is ready for use. It is supposed to act mechanically by the sharp bristles penetrating the worms and causing their death. The dose is one teaspoonful every morning for three days, after which a purgative should be given.

Treatment for the expulsion of the *tape-worm* should be quite different from that employed for any of the other intestinal worms. Preparatory treatment for about forty-eight hours is required before the vermifuge is administered. During this time the patient should take a mild purgative once or twice, and such food, in moderate quantity, as leaves little matter in the bowels—such as beef-tea, milk, etc., with some stimulant if there is exhaustion. There

are three articles of food which experience has shown to be especially useful in this preparatory treatment, perhaps from a sickening effect they produce on the worm, namely: salt herrings, onions, and garlic. These articles may therefore be taken as food during the twelve or eighteen hours preceding the employment of the vermifuge.

The various antidotes for the tape-worm recommended in the books are probably all more or less useful, but the one which has given most satisfaction in the Out-door Department of Bellevue Hospital, where, probably, a larger number of these cases are treated than anywhere else in this country, is the oil of male fern, but it has been found best to give a somewhat larger dose than is recommended in some of the books. To a child of six years one teaspoonful should be given in any convenient substance, such as the syrup of Tolu, or syrup of orange-peel. This should be followed in about four hours by a dose of castor oil, which completes the cure.

Kosso, which consists of the flowers and tops of an Abyssinian tree; pumpkin-seed, the rind of the pomegranate, or turpentine given in a large dose, also cause expulsion of this worm.

Since the symptoms produced by the *thread worm* are referable to the rectum, and are caused by the active movements of the worms, the prompt and thorough use of injections which may cause their expulsion is evidently required. The injection when given cool, is more effectual than when warm, and, since this parasite occurs in all parts of the large intestine, and its chosen habitat is the upper end of this division of the intestinal tract, large enemas given through a flexible tube, or a large catheter well introduced, bring away a larger number of the worms than small injections employed in the usual way. Various substances have been used for this purpose, as lime-water, table salt in water, turpentine in milk, decoction of aloe, etc. Heller, who has given much attention to the study of intestinal parasites, and is recognized as one of the best authorities in reference to them, says of the use of injections: "Simple water would do well for this purpose, for in a short time it causes the worm to swell up and burst; but that is not altogether without an injurious effect on the mucous membrane. Hence, Vix recommends a solution of Castile soap in distilled water or rain water, of the strength of one to two and a-half grains to the ounce. This has no unpleasant effect on the mucous membrane of the bowel, while at the same time it quickly destroys both the worms and their eggs." The use of the injection in the evening, even with a small quantity of liquid, procures relief from the itching and quiet sleep during the night.

But it is undeniable that injections do not effect a complete and permanent cure in a large proportion of cases, and hence those affected with the thread worm remain sufferers for years ; having only a temporary respite unless medicines are administered by the mouth. Those medicines which produce free watery evacuations appear to be the most effectual in dislodging and expelling thread worms, whose attachment to the intestinal surface is not strong, and hence Heller recommends the saline purgatives (such as Epsom salt or Rochelle salt) "joined with copious draughts of cold water."

Intussusception.

The term intussusception is applied to an obstruction of the intestine, produced by the descent of the part above into that below ; just as the finger of a glove is sometimes doubled upon itself in withdrawing the finger. It is one of the most painful and dangerous maladies, but fortunately is not very frequent. I have records of fifty-two cases occurring under the age of twelve years. In thirty-four of these the previous history was obtained, and it is stated that seventeen of these were apparently in good health until the symptoms of intussusception began, while the remaining seventeen had some ailment, usually affecting the action of the intestine, as constipation, diarrhœa, etc. Any irritating agency which stimulates the intestines to irregular action, must be regarded as a cause, as the use of irritating and indigestible food, worms, etc. Rarely, external violence is the apparent exciting cause. One patient received a severe bruise of the abdomen two years before death, and from this time continued to complain, at intervals, of pain in the bowels. One writer also mentions the case of a child, aged nine years, who received a blow from a comrade in school, and from this time had alternate diarrhœa and constipation till the intussusception began. Rilliet and Barthez also relate the case of two children in whom this displacement suddenly began when their parents were tossing them in their arms.

One-fourth of all intussusceptions occur during the first eighteen months of life, and, with few exceptions, after the third month. The seat of this displacement in children is, in almost all instances, the large intestine, this either constituting the entire mass, or else its external portion, while the internal or displaced part consists of small intestine. The exceptions to this are so infrequent that they need not be regarded in a general description of the disease.

There may be so little narrowing of the affected portion of the intestine that the food continues to pass through it. In such a

case the displacement may continue for weeks, or even months, the passage of matter being sufficiently free for the maintenance of life, till, finally, death occurs in a state of exhaustion. Thus, in one instance, a child aged four months lived six weeks after the symptoms commenced, and for seventeen days with a portion of the bowel protruding from the anus. It was found at the examination made after death, that the lower part of the small intestine had descended through the entire large intestine, and yet had remained open. But such a result is exceptional. Ordinarily, as the upper portion is pushed into the lower portion of the bowel, its vessels are constricted, and intense congestion results. The undue pressure and the friction of the surfaces against each other excite inflammation.

Very soon, therefore, in ordinary cases, the condition becomes one of great gravity, since, in addition to the inflammation, gangrene commonly occurs (if the patient live long enough) in that part in which the circulation of blood is arrested. In infants, usually within a few hours, so great is the congestion that blood escapes from the distended vessels into the intestine below and passes in scanty motions. The continuance of bloody stools unmixed with fæcal matter, after the first few evacuations, are so uncommon in the infant that their occurrence should at once lead us to suspect the nature of the disease.

The symptoms vary according to the age of the patient and the severity of the case. Pain in the belly, commonly in paroxysms, is one of the first symptoms. It is often severe like that of colic, and it continues more or less continuously. After a few days the pain is more constant if inflammation have occurred. Vomiting is also a common symptom, as it is in all cases of obstructive disease in the intestines.

At first, pressure on the abdomen is tolerated, and it may even seem to give relief, but when inflammation has occurred pressure gives pain. The abdomen, at first, if of natural fulness and soft, becomes more and more bloated in fatal cases till the close of life, but in cases of much vomiting the bloating is moderate. This is due to gas and collection of fæcal matter above the seat of the obstruction.

The intussusception often produces a swelling which can be felt through the walls of the abdomen on firm pressure. The appetite is impaired, and often entirely lost, but infants at the breast commonly nurse for several days, probably from thirst rather than hunger. As soon as the strangulation occurs, obstinate constipation of course results. There may be one or two natural stools at first, and then no more evacuations occur in older patients, and

in infants only the scanty bloody motions alluded to above. Straining, as if to pass a stool, is a common symptom. It sometimes does not begin till there is a considerable amount of displacement, and it ceases when the strength is greatly reduced. In all cases which are not relieved, patients progressively, and usually rapidly, waste away.

Intussusception is so grave an accident, that a fatal result must always be expected. Nevertheless, there are three modes of termination in which life is preserved, namely: first, the reduction of the displaced mass with immediate relief; second, its death, separation, and expulsion through the bowel, while adhesive inflammation unites the edges of the intestine, which have retained their vitality; third, a mode of termination not fully understood, but in which, probably, shrinking of the strangled intestine, plays an important part.

Treatment.—It is unfortunate, in cases of this accident, that the time in which treatment can be of most service is apt to pass by before the true state of the intestine is discovered. Invagination being comparatively rare, is apt to be mistaken for colic, dysentery, or some other intestinal malady. Not infrequently, the physician, though called early, does not discover the nature of the attack till the second or third day; and the longer correct treatment is put off the greater the difficulty will be of effecting a cure. Purgative medicines, often given in the commencement, injure the patient, for cathartics act in such manner as to cause still further descent of the inverted intestine; yet such powerful agents of this class, as quicksilver, have been employed. Quicksilver had been given by the mouth, in two one-ounce doses in a case which I observed, and it need not be stated that the child speedily died.

The proper treatment of intussusception consists in attempts to reduce the displacement by pressure from below, either by liquid injections, or filling the rectum by gas or air. Injections should be made with lukewarm water, for cold or hot water may cause contraction of the muscular fibres of the intestine, and prevent that degree of relaxation which facilitates the reduction. The child should be placed in bed, or in the mother's lap, with the hips raised much higher than the body. With the common India-rubber, or better, the fountain syringe, and the aid of an assistant, the liquid should be gently, but with sufficient force, thrown into the rectum, until the bowel is distended to the fullest extent. The liquid should be retained, so far as possible, by pressure upon the anus; the abdomen should be firmly and deeply kneaded by the fingers, the movement being made chiefly from the region of the stomach downward on the right side of the abdomen, which presses the water in a direc-

tion opposite to that which the intussusception usually takes. This firm but gentle kneading of the abdomen should be continued from five to ten minutes, when the water may escape. After the patient has been allowed to rest a short time, the same operation may be repeated if the displacement is not corrected. But when sufficient trial of water has been made, and the symptoms indicate the persistence of the intussusception, the case should not be abandoned without the trial of other measures. Air may be blown into the bowel by a well-constructed bellows, with a proper nozzle or elastic tube attached, or better, by the use of the double-bulbed hand atomizer. Carbonic acid may be produced and introduced by methods which an intelligent physician can employ. I have used for this purpose, successfully, an inverted siphon of carbonic acid water, with a No. 18 catheter attached.

If attempts to effect a return of the intestine to its proper place fail, a warm poultice should be applied over the abdomen, and opiates and stimulants administered. Though death is the ordinary result of an intussusception which has not been reduced either by inflation or the use of water injections, still recovery is possible, as we have seen above, either by death of the strangled portion, or shrivelling of the mass. In a few instances, also, intussusception has been relieved, and life saved by the operation known as *laparotomy*, which consists in opening the abdominal cavity so that the intussusception can be reached and removed by the fingers.

J. LEWIS SMITH, M.D.

THE NERVOUS DISEASES OF INFANCY AND CHILDHOOD.

BY

MARY PUTNAM-JACOBI, PH.G., M.D.,

OF NEW YORK CITY,

PROFESSOR OF MATERIA MEDICA AND THERAPEUTICS IN THE WOMAN'S MEDICAL COLLEGE OF THE NEW YORK INFIRMARY; CONSULTING PHYSICIAN TO THE NEW YORK INFIRMARY AND ATTENDING PHYSICIAN AT THE OUT-DOOR DEPARTMENT OF THE MOUNT SINAI HOSPITAL, ETC., ETC., ETC.

THE NERVOUS DISEASES OF INFANCY AND CHILDHOOD.

ANATOMY AND PHYSIOLOGY.*

A FEW details in regard to the anatomy of the nervous system are indispensable to the most superficial comprehension of its disorders. The nervous system consists essentially of two parts. 1st. Masses of nerve-tissue grouped into definite shapes, and contained in bony cavities more or less completely closed. These are called the "central nervous organs," or "nerve-centres." 2d. Threads of nerve-tissue, called nerves, which run like telegraph wires from every part of the body to terminate in the nerve-centres.

The nerve-centres are composed of three parts: 1st. The *brain*, contained in the perfectly closed bony case called the skull. 2d. The *spinal cord*, contained in the spinal column, an imperfectly closed bony canal which extends the whole length of the back. 3d. The *medulla oblongata*, or mass of nervous tissue which joins the brain and spinal cord together, and is situated at the lower part of the head and back of the neck.

The nerves are divided into two sets: 1st. Those which run directly between the skin and muscles on the one hand, and the brain or spinal cord or medulla on the other. These are called the cerebro-spinal nerves (brain-spinal). 2d. Those which run from the blood-vessels, or from the internal organs contained in the chest and abdomen, and which pass through a chain of small nerve masses, called ganglia, before going to the spinal cord or brain. Some of these ganglia lie in front of the spinal column, in the chest, and deep in the abdomen; but besides those there is, inside the spinal canal, on each side of the spinal cord and near

---

[* See, also, Chapter on Anatomy and Physiology.]

to it, a regular chain of ganglia, placed at equal intervals from each other like a string of beads. All these ganglia are called "sympathetic" ganglia, and the nerves running to them and from them, and through them, are called "sympathetic" nerves, because they have been said to establish a kind of sympathy between distant organs. The very fine nerves which go to the blood-vessels are called "vaso-motor nerves," and belong to this last variety.

The brain, medulla, and spinal cord, the "central nervous organs," are composed of two kinds of tissue called, respectively, the gray and the white. The latter is composed exclusively of fibres, much resembling those which make up the nerves, large and white, and running in parallel layers or bundles. The former consists of finer fibres, gray in color, and arranged in an intricate net-work. In meshes of this, in certain definite localities, are imbedded groups of cells of various shapes and sizes. The material constituting the body of these cells is identical with that which makes up the fine fibres of the gray net-work ; and these again are equivalent to, if not identical with a gray thread which runs as a central axis through the large white fibres of the white tissue. A final point of importance to notice is, that all the cells are connected with fine gray fibres, although as the mass of these and white fibres together is about a hundred times that of the cells, it is impossible that all the fibres should terminate in cells.

The relations of position of the gray and white substances to each other is exactly reversed in the brain and spinal cord. The cord consists of a central column or core of gray substance, almost completely surrounded by a hollow cylinder composed of bundles of white fibres. The brain, on the contrary, is composed of an immense core of white fibres, radiating like a solid fan from a narrow base to a wide surface ; and all over this surface is spread a layer of gray matter. This, therefore, lies just under the bones of the head. There is a great deal more of it than could be accommodated in a single flat layer, and so it is doubled up in an immense number of folds. These are the so-called "convolutions" of the brain.

The convolutions thus contain the principal amount of the gray matter of the brain. But in addition, much smaller masses of gray matter are located at intervals along the base of the brain, and in the medulla. From some of these masses arise the nerves of the head and face, of which there are twelve pairs in all.

The gray matter in the interior of the spinal cord also gives rise to nerves—indeed, all the remaining nerves of the body. This central gray column has a peculiar shape. If it be cut through at

any point, the surface of the section looks as if two half-moons or crescents had been joined by their convex sides, thus forming four prolongations in the surrounding white tissue. These are called the two anterior and two posterior horns. In the former originate the motor nerves, that is, those going to the muscles and transmitting to them from the brain the force to move. To the latter come the sensitive nerves, which bring impressions from the skin and other parts of the body. These, after reaching the posterior horns of gray matter, are transmitted to the brain, partly by fibres of the gray matter, partly by the fibres in the posterior column of white tissue.

DISEASES.

Diseases of the nervous system are in childhood less frequent than diseases of the digestive organs, or, according to some authorities, than diseases of the respiratory organs or of the skin. Thus Meigs quotes from the Philadelphia bills of mortality from 1844 to 1848, that the cases of nervous diseases of all kinds were 3,970; of diseases of the digestive organs, 4,204; of the respiratory organs, 3,376. The statistics of Barrill, however, compiled in Paris, show a predominance of diseases of the chest. He ranks these as two-fifths of the entire number of children's diseases; diseases of the abdomen as one-fifth; of the senses, including the skin, and the eruptive fevers, as one-fifth; and diseases of the nervous system as only one-tenth. But these latter are so much more dangerous in proportion to the number of cases, that they remain the most impressive for the imagination. Thus the mortality of diseases of the nervous system has been rated at 68 per cent.; of diseases of the chest, at 48 per cent.; of the senses, (including and principally comprising the skin), at 40 per cent.; and of the abdomen, at 32 per cent. In other words, as might be expected, the severity of the various classes of diseases is in inverse proportion to their frequency.

The nervous system in children presents more marked peculiarities proper to their age than does any other portion of their organism; and these peculiarities are observable during a longer period of time than is the case with those of other systems. Thus, under two years of age, the digestive organs, exercising their functions upon special kinds of food, are quite specially liable to functional disturbances; and these, as gastric indigestion and diarrhœa, are immeasurably more important than the same affections in later life. But this special liability ceases when, with

the completion of dentition, the diet of the child ceases to be peculiar; namely, at about the middle of the third year. Again, the organs of locomotion, the bones, joints, and muscles, which are the seat of very active processes of growth and development in early childhood, are, on this very account, very much more liable to disease than in adult life; but this great excess of liability diminishes rapidly after the completion of the second dentition, that is, after the eighth or ninth year. But many of the peculiarities which distinguish the diseases, or even the habitual condition of the nervous system in children, persist from infancy to puberty; and others, although necessarily absent from infancy, and occurring only in later childhood, still suffice to contrast this period with that of adolescence or of mature life.

The main reason for this fact is that the nervous system changes in its internal structure more than any other, at different stages of its growth; and that slight changes in its structure result in very much greater changes in its modes of action than is the case with the organs of respiration, or of digestion, or even of locomotion, and peculiarities in the form of the healthy working of organs always determine peculiarities in the form of the diseases to which these organs are liable.

Now, the first great peculiarity in the diseases of the nervous system in children consists in the preponderance, in them, of organic over functional disorders. That is to say, children are, as compared with adults, much more liable to inflammations of the brain and spinal cord, and much less to such diseases as neuralgia, consisting in a perversion of the function of sensibility without any visible alteration in the substance of the nerve tissues affected. This liability to inflammation is greatest in the brain, and greater in inverse proportion to the age of the child.

This is equivalent to saying that the danger of inflammation is greatest at the time when the nutrition of the brain is most active. For, during the first year of life the weight of the brain constitutes more than fourteen per cent. of the weight of the entire body; whereas in the adult it is only two and one-third per cent. In the infant, therefore, the share of the brain in the general nutrition, and in the general blood supply, is seven times as great as in the adult; and experiment has shown that the nutritive processes are proportionately very much more active. But an organ to which more blood is sent, is, other things being equal, much more liable to inflammation than one which receives little; and for the infant brain, we might in advance anticipate a danger, which is only too often realized in fact. It is interesting to notice that there is little danger of inflammation from an abundant supply of blood

to the brain for the purpose of enabling it to perform its functions with greater activity, but only when it is used for the purpose of growth and development of the tissues of which the brain is composed. Therefore, the adult man, whose brain has ceased to grow, may use this organ to its utmost powers, summoning to it an immense amount of blood in the act of thinking, and yet, by so doing, will incur comparatively little risk of inflammation. But the infant who cannot think at all, whose cerebral circulation is devoted to building up an organ of thought for future use, is threatened with congestion, and even fatal inflammation of the brain, from, apparently, the most trifling derangements of its circulation.

A second peculiarity about nervous diseases in children, is the preponderance of disorders of motility over disorders of sensibility. Thus children suffer readily from convulsions, or exaggerated action of muscles, and not unfrequently from paralysis, or loss of muscular action: but they rarely have pain apart from some tangible alteration of the part to which the pain is referred. Even the nervous pains in the belly—the wind colics—which constitute the characteristic torment of babies, depend upon chemical alterations in the contents of the bowels, whose effects are tangible, and, could we look inside, would be perceptible to our senses in the gases and acids which had been generated there. But, as already observed, children do not have neuralgia, nor the sharp pains of hysteria, nor headaches—all modes of suffering unattended by tangible alterations of the suffering part; and the nervous irritations of inflammations, which, in adults, are chiefly expressed by pains, in children will often result in convulsions.

The reason for this marked peculiarity lies in the mode of development of the nervous system. This is formed from without inward—that is to say, the nerves going to the muscles and skin are formed first and completely developed; while the nervous tissues of the brain and spinal cord, although appearing at the very beginning of embryonic life, remain for a long time in a semi-pulpy condition, and are not completely elaborated until long after birth. When we say that the power to move, to feel, and to think, depends on the brain and spinal cord, we mean that the organs of motion, feeling, and thought exist there; or that, in this general mass of nerve-tissue, certain portions are appropriated to the fulfilment of these different functions. These organs may be described as consisting of masses of microscopic bodies called nerve-cells imbedded in masses of intricate fibres much finer than those of the nerves.

The extent to which the human being is able to move, and feel, and think, depends upon the degree to which this complex tissue,

perhaps especially the cells in it, are developed. There is a time before birth, when the body of the child has attained considerable size, when, as has been said, the brain and spinal cord consist of a semi-liquid pulp, and there are no masses of cells in it at all. These appear gradually and grow gradually, but even when the baby is born they are still very incomplete. Each group contains fewer than the typical number, and these are smaller and of a different shape from what they will be in adult life. The masses of cells from which come the nerves for the muscles, are thus unable to send much force down to the muscles, and hence the new-born child moves its limbs feebly and aimlessly, and it is two years before these movements begin to acquire precision and vigor. In the same way the masses of cells to which come the nerves of feeling, bringing to the brain the various impressions which have been made on them, are also imperfect, and hence a baby or a young child feels all impressions very vaguely and with much less intensity than does an adult ; and the same imperfect development of the highest part of the brain, render thought, and for a long time even self-consciousness, impossible. In the mean time the nerves, which run all over the body, although small and delicate, like all the tissues, are nevertheless possessed of the same structure they are destined to have throughout life. They are able, therefore, to fulfil their functions very well ; are able to carry impressions to the brain from the skin and internal organs, and able to carry impulses from the brain to the muscles. In fact, the diffusion of impressions throughout the nervous system is much more rapid in infants and children than in adults ; the nerve-fibres offer, as it is said, less resistance to the passage of these impressions. There are multitudes of nerve-fibres running between the masses of cells in the nervous tissues of the brain and spinal cord, and impressions are diffused along them with the same increased facility that is observed for the nerves. The extreme liability to convulsions in children depends largely upon these two facts, namely : 1st, the rapidity with which impressions may be diffused throughout the fibres of both the internal and external part of the nervous system ; 2d, the early development of muscles and of nerves, as compared with that of the brain and spinal cord.

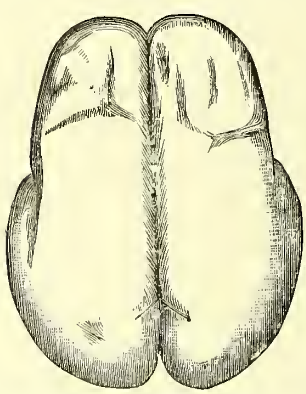


FIG. 224.—Upper surface of the brain of a fœtus showing the absence of the furrows and convolutions of gray matter which subsequently appear.

Thus, suppose that the stomach of the child has been loaded with some indigestible food and the nerves of the stomach are irritated, the impression is rapidly conveyed by these nerves to the spinal cord, and as rapidly travels along the spinal cord to the isthmus in the upper part of the neck which joins the spinal cord and brain together—the so-called medulla oblongata. Here it encounters and irritates a great mass of cells, and from this point the irritation is sent back again, along other nerves, to muscles all over the body, throwing them into cramps, spasms, convulsions. This is the way convulsions are brought about, and much more easily in the child than the grown person : 1st, because the irritation travels more rapidly from the stomach to the "nerve-centres" (the spinal cord, medulla, and brain) ; 2d, because it is disseminated more rapidly along the internal fibres of these centres ; 3d, because a comparatively feeble impulse sent to the muscles from even the mass of imperfect cells in the medulla will excite a great deal of action in the well-developed nerves and muscles ; 4th, because the upper part of the brain, which, in adult life exercises a restraining influence over the medulla and the spinal cord, and enables them to resist the irritating impressions brought to them, is, in childhood, too feeble to do this effectively. This restraining influence is very curious and difficult to be explained to persons unacquainted with physiology. The nearest attempt at an explanation may, perhaps, be made by a simile : If a pendulum receive a blow which carries it out of its orbit, it tends, before returning to its own place, to swing into exactly the opposite direction. But if a strong hand be laid upon it, it may be gently returned to its own place without passing through any stage of violent reaction. In some such way does an influence constantly emanate from the healthy adult brain to the parts of the nervous system lying below it, and restrain them from reacting excessively upon the irritating impressions which may be brought to them.

But if the irritation cannot be reflected backwards upon the nerves and muscles, causing convulsions in the manner described, it dies away without being felt. For when it travels to the masses of nerve-cells, which are the seat of feeling, it finds them in so undeveloped and rudimentary a condition, that it cannot excite them to their customary reaction, that is, it cannot excite in them the feeling of pain, or does so only imperfectly. In the adult, where the nerve-centres are restrained from reflecting impressions to the muscles, these impressions remain in the nerve-centres themselves, and intensely irritate the highly developed organs of feeling, causing, often, great pain. But this fortunately is almost impossible in a young child. For them pains are chiefly caused by

alterations of tissue in which the well-developed nerves are imbedded, as in inflammations. On this very account, pain in a child, when it does occur, is generally of more serious significance than in an adult. With the exception of the bowels, any part of the body which is the seat of pain may be suspected of some kind of inflammation. This is especially important to remember in regard to the head. A headache in a child is as rare as is a convulsion in an adult ; and while in the latter it often indicates nothing but indigestion, constipation, or fatigue, in a child it must at once awaken alarm as the possible forerunner of one of the most terrible diseases of childhood—brain fever.

The imperfect development of the masses of cells in the central nervous organs (brain and spinal cord), is the cause of another striking peculiarity in children. I mean the readiness with which they are fatigued. The force necessary for moving the muscles of the body is generated in the masses of cells in the central nervous organs, by the action of the blood upon them, and the transformation of impressions brought from without. In some respects the process may be likened to the generation of electricity in a battery, by the action of the battery fluid on the plates ; and as the electricity is carried from the battery along wires, so is the nerve-force carried from the cell-masses along nerve-fibres. Now, in adults, the cell-masses store up in reserve a good deal of the force generated in them. They part with it gradually, and it is only after very prolonged or excessive exertion, that the stock of accumulated force is exhausted. When this happens, we say that the individual has been exhausted from overwork, and we know that a long period of absolute rest is required before his strength is recuperated. Now, with children, the store of force accumulates rapidly, but is as rapidly dissipated. Hence their extremely quick agile movements, their incessant motion, during short periods of time. The movements are neither massive nor powerful, but they are complex, and involve a great expenditure of nervous energy. As soon as the store of nerve-force accumulated has been expended, fatigue follows, and the child, when healthy, at once falls asleep. But woe betide the poor little child who is forcibly prevented from resting at these short intervals ! Under the age of four years, there are perhaps few children whose rights to repose are violated ; but above that age, thousands of children have been murdered in factories by the cruel, unremitting duration of hours of labor, even at occupations not in themselves laborious. There is no more heart-rending page in the history of human oppression than that which describes little children of five and six years old falling asleep at their factory looms, to be aroused by

the blows of the overseer. This dreadful misery is now happily a thing of the past; but children are still overworked, and that even in the favored classes, where the excessive exertion is generally made at school. Many people, while absurdly solicitous lest their children should overtire themselves by physical exertion, by running, and leaping and jumping, make no scruple of enforcing attention to books, and cramped position on school benches for several hours at a time. Now, in this connection, it is important to notice two things : first, that no position affords real rest except that of lying down. A child, when sitting still, is obliged to make a double expenditure of nerve-force, to innervate the muscles which are holding the body upright, and to restrain the diffusion of force to other muscles which are longing to escape with free action, or active movement. This effort is more painful, and hence more fatiguing to the child than much violent muscular exercise. Second, that the act of attention, or work of the mind, is accompanied by a discharge of force from the masses of cells in which it accumulates, quite analogous to that involved in the movements of the limbs. Only, this force, instead of passing externally along the nerves to muscles, is discharged along the internal fibres of the brain. This internal expenditure of force causes really more fatigue than does the external expenditure : in other words, mental action is relatively more fatiguing than muscular action. It is so even in the adult ; but still more in the child, from the fact we have so many times insisted upon, namely, that the fibres of the nerves are well developed, and able, therefore, to transmit impressions with facility ; but the internal fibres of the brain are imperfectly developed, and the work of transmission of impressions along them is, therefore, more burdensome.

The law of mental activity for the child is precisely analogous to that of physical activity. Force is generated in the masses of cells which subserve the functions of thought in small quantities ; the amount so accumulated at one time is readily dissipated, and repose is needed to recuperate. This is why children's attention cannot be long fixed on any one object ; incessant change and variety are absolutely essential to the health of their mental as of their physical action. and the attempt to enforce prolongation of effort after signs of fatigue appear, is as useless as barbarous. The fatigue and inattention show that the supply of nerve-force is, for the time being, exhausted, and there is no way of renewing it except by rest.

There is another reason for this ready exhaustion, beside the imperfect development of the nerve-tissues on which the generation of force depends, and this is the constant demand made on it

by the rapid growth of the body. At three years of age, the child has generally reached about half the height he is destined to ultimately attain, and yet the process of growth scarcely begins to slacken at this time. The process of growth involves two things: the assimilation of new material, and the shaping of it into form similar to that possessed by the old. It is not enough that flesh and blood are formed from the food and brought to the young limbs; each fold and dimple of these must be moulded as delicately as clay at the hand of a sculptor. It is the nerve-force sent down to the limb from the brain and spinal cord which presides over this moulding. If the nerves of a limb are paralyzed, or if part of the spinal cord is destroyed while the processes of growth are going on, the limb will be shapeless and unsymmetrical. Hence, the mere silent, passive process of growth in a child involves an expenditure of nerve-force—in other words, a drain upon the store accumulated in the masses of cells and network of fibres of the central nervous organs. This is a drain which ceases in adult life, after growth is completed, but while it lasts it diminishes by just so much the reserve of force which may be expended in mental and physical action. Hence the amount for this expenditure cannot fail to be conspicuously inferior in childhood, and that for a double reason: 1st, less force is generated in the nerve-cells on account of their incomplete development; and 2d, a special expenditure is required in the process of growth, leaving less in reserve for such expenditures as are common to childhood and adult life.

Nervous diseases are divided into two great classes: those in which a visible alteration of the structure of nervous organs may be found after death, and those in which no such alteration exists, no matter how violent may have been the symptoms of the disease.

Congenital Diseases.

There are a certain number of diseases of the nervous system which seem to begin during infancy, but which in reality depend upon injuries suffered by the brain before the birth of the child.

Absence or Deficiency of the Brain.

Sometimes hemorrhage and sometimes inflammation destroy portions of the fœtal brain, and the consequences of such an accident vary, chiefly, according to the age of the fœtus at the time it occurs. When this is very early in intra-uterine life, before the

bones of the skull have been formed, all the brain above the medulla oblongata may be destroyed. When the child is born, the face and body will be well formed, but in the place of the head will be found a hollow, empty, bony cavity, sloping backward from the level of the eyebrows. The baby has become a "monstrosity," incapable of life, after its birth, for more than a few hours, and is often still-born. The reason that life may sometimes persist for several hours, is that the medulla and spinal cord are intact, and therefore the respiration may be established and the beating of the heart go on.

When hemorrhage takes place into the brain at a later date, the substance of the brain does not entirely disappear as in the first case, but becomes converted into a reddish mass, part of which protrudes through an opening in the top of the flattened skull; but the brain is as effectively destroyed as in the other case, and life as impossible. Only these "monsters" are called "*Pseudencephalic*," *i. e.*, "false brained," instead of "*acephalic*," or "deprived of brain."

Water in the Brain—Hydrocephalus.

Sometimes, instead of an effusion of blood into the substance of the brain, there may be an effusion of liquid into the cavities of the brain, greatly distending them. The tissues of the brain are gradually pressed upon, being pushed outward toward the roof of the skull, and the yielding bones of the skull are also pushed apart. When the amount of fluid diffused is very great, the size of the head becomes enormous, but the size of the brain constantly diminishes under the pressure to which it is subjected from within, so that finally the brain-tissues are reduced to a thin, pulpy layer just lining the almost papery skull.

When the head attains a very large size during intra-uterine life, the birth of the child may be rendered impossible. More often, however, the excessive development does not begin until a few months after birth. The effusion may already have begun before the baby was born, but, accumulating very gradually, does not, for a long while, excite any symptoms, and no alarm is felt until attention is called, generally by outsiders, to the disproportionate size of the baby's head. Such children generally die after becoming completely paralyzed; but, in not a few cases, the fluid ceases to form, the head ceases to enlarge, the bones unite and ossify completely, and, the entire disease arrested, the child is cured, but remains rather "top-heavy" to the end of his days.

Arrest of Development of the Brain.

There is still a fourth way in which the brain may become reduced in size—not, this time, by pressure from within, but from without. Every one knows that in a new-born baby's head the bones are soft, and are not joined completely ; spaces are left between them, of which the largest is just above the forehead, and lozenge-shaped, and known as the *anterior fontanelle.* This is placed over the part of the brain which is the least developed at birth, and requires to grow the most, containing the principal organs of thought. Now this fontanelle properly does not close until the child is fifteen months old, thus leaving room for the expansion of the cerebral hemispheres. But sometimes, by a perversion of nutrition, the brain grows too slowly, and the bones grow too fast, become heavy and thick, and join solidly together, so that further expansion of the brain is impossible. It therefore remains permanently small and undeveloped ; the skull is said to be "prematurely ossified," and the child is "*microcephalic,*" or small-brained.

If the ossification of the skull be completed before birth, it may cause as great an obstacle in the labor as hydrocephalus, since the head could not be compressed by forcing the bones to overlap each other, as is the case with healthy infants. It is rare, however, that ossification is completed so early ; but the skull may be entirely closed by the age of five or six months, and afterward, although the head may grow with the general increase in size of the body, yet the brain will remain dwarfed.

This condition is one of the most common causes of idiocy, which is more or less complete, according as the development of the upper or thinking part of the brain has been more or less arrested. When a child, whose bodily stature and physical health are good, remains unable to walk at two, three, or four years old, or unable to use its hands, or to sit up or hold its head erect ; when it cannot speak (although possessing, perhaps, remarkably fine teeth), and shows very imperfect comprehension of what passes around it—it will generally be found that the growth of the brain has been arrested, either by compression from without, from the premature ossification of the skull, or by compression from within by effusion of fluid into its central cavities.

Finally, the accidents of inflammation or of hemorrhage, which we have described as capable of destroying the entire brain, are sometimes so limited in their extent that only a small portion is destroyed. At birth the child's head looks all right, but later ap-

pear paralyses, confined to one limb, or involving nearly all the muscles of the body; the intelligence is found to be greatly deficient, and the power of speech remains either absent or very imperfect.*

Want of Power of Speech.

There is a certain portion of the outer surface of the left side of the brain which seems to stand in especial relation to the faculty of speech. If hemorrhage occur, limited to this region, and just before birth, or even during labor, it may happen that the child never becomes able to speak, although showing no other defect, either mental or physical. There is always a possibility that the other half of the brain may be finally trained to perform vicariously the work of speech, and then the child will finally acquire the function that seemed lost to him.†

Rigidity of the Limbs.

Still another form of disease, not very uncommon, depends upon ante-natal accident. In this the child does not appear at first sight to be paralyzed, and when lying in bed will seem to move its limbs quite freely. But when it attempts to stand, the legs stiffen rigidly, it can neither bend them, nor support itself. still less walk. Sometimes only one leg is affected and then the arm on the same side of the body is generally affected in the same way. That is, it seems to be in a normal condition until the child attempts to use it for some definite purpose, as grasping an object, when at once it stiffens from the wrist to the shoulder, or is bent forcibly at the elbow-joint, the hand approaching the upper arm. Often, the thumb, or even several of the fingers, are clenched in the palm of the hand. After a few minutes' repose, the attack of rigidity passes off.

Children thus affected are sometimes quite intelligent, and are well able to speak; in other cases the faculty of speech is imperfect or abolished, either alone or with accompanying deficiency of intelligence. When the child is *aphasic* (*i. e.*, unable to speak), it will often be noticed that the attacks of rigidity, and consequent inability to move the limbs, predominate on the right side, or are altogether confined to it. This fact confirms the diagnosis of disease in the *left* side of the upper surface of the brain, because diseases on one side of the brain always affect the limbs on the opposite side of the body. There is reason to suppose that in the con-

[* See, also, chapter on Idiocy. † See, likewise, chapter on Deaf-Mutism.]

dition described there has been before birth a circumscribed inflammation of some part of the surface of the brain, which, in itself, has ceased by the time the child is born. But the tissues of the brain below the seat of the old inflammation begin to alter : a sort of ribbon of altered tissue is formed, passing down through the brain and along a certain part of the spinal cord ; and it is to the irritation caused by this gradually progressive alteration—a species of chronic inflammation—that are due the attacks of rigidity in the limbs so soon as the child begins to use them. Sometimes this slow inflammation extends to that portion of the medulla oblongata whose irritation, as already described, gives rise to convulsions, and then the child becomes liable to convulsions for the period of a year or two. This susceptibility generally subsides, and fair general health is established. But, in our present state of knowlege the disease itself cannot be considered curable.

Absence of Spinal Cord.

Besides the accidents just enumerated, which may affect the brain before birth, are a certain number involving the spinal cord. The first of these is only an extension of the morbid process which we have described as destroying the embryonic brain, or as entirely arresting its development. When the brain alone is absent the child is said to be born *anencephalic ;* if the spinal cord is also gone, there is said to be *amyelie* (from α, without, and μυελος, spinal cord). The absence of the cord is rarely as complete as that of the brain may be ; but the spinal canal is often filled with a bag of membranes containing fluid, in which float elements of nerve tissue.

Fissure of the Spine—Spina-bifida.

Another congenital lesion of the cord is of much more practical interest, since the children born with it are by no means monsters, but well formed and well capable of living. This consists in a *hernia* of the membranes of the spinal cord, or their protrusion in the form of a bag through an opening in the bones of the back (vertebral column). This opening is nearly always situated at the bottom of the back, at a point where the spinal cord breaks up into a great bundle of nerve-fibres destined for the lower limbs, and called the *cauda equina*, or horse's tail. These nerves float out in the fluid which fills the membranous bag, and are spread over its internal surface.

This hernia is called *spina-bifida,* or cleft-spine. In itself it

occasions no inconvenience, but the child is in a state of constant liability to danger from injury. A blow may burst the bag, or the friction of the clothes may gradually ulcerate it. The inflammation of these membranes may extend to those of the spinal cord, and thence to the brain. But even where the membranous bag has not inflamed, the mere escape of fluid is very liable to determine inflammation, because fluid is thus drawn off from all along the

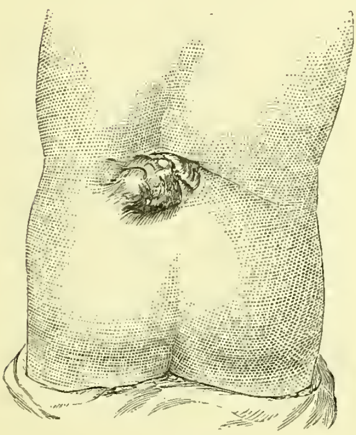


Fig. 225.

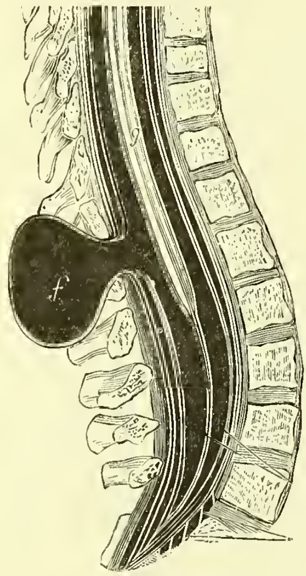


Fig. 226.

Figure 225.—A case of cleft spine, or spina-bifida.
Figure 226.—Diagram of a case of cleft-spine; f, the sac containing the protruding membranes; g, the spinal cord.

spinal cord and the brain; a vacuum is created, and blood rushes instantly to the blood-vessels to fill it up. This congestion generally results in fatal inflammation.

Treatment.—Nevertheless, on account of the dangers to which a child who carries such a tumor on his back is constantly exposed, it is not unusual to attempt to cure it by puncturing, in order to allow the escape of the fluid, then injecting tincture of iodine for the purpose of setting up a moderate inflammation in the membranous bag, by means of which its walls may adhere together and its cavity be obliterated. When this can be done with safety, the opening in the bones gradually closes and the child is cured, but with a little fold of skin permanently hanging

from his back. The operation—although, for the reasons stated, always a dangerous one—is nevertheless sometimes successful.

On the other hand, it does sometimes happen, though rarely, that the communication between the spinal cord and the external bag closes spontaneously, the bones close, and the tumor remains quite superficial and may be removed like any other tumor. Sometimes, also, constant pressure on the surface of the tumor, by a well-adjusted pad, keeps the fluid contents of the bag constantly forced into the cavity of the spinal canal, and then, after many months, the spontaneous obliteration of the opening takes place as before. This last method is the safest, and decidedly to be recommended—at least for trial—before having resort to any real operation, of which even simple puncture—which seems so trifling—may really prove extremely dangerous.

Bleeding into the Spinal Cord.

I do not know of any cases in which hemorrhage into the spinal cord can be supposed to have occurred before birth. But sometimes, during a labor in which instruments are used, the compression of the child's head will cause an effusion of blood at the base of the brain, a portion of which may trickle down into the spinal canal and compress the spinal cord. This compression may occasion convulsions, or even a species of tetanus resembling strychnine poisoning. But the symptoms, however alarming for the time, very generally subside without serious consequences.

Tetanus of the New-born.

Far more real danger lies in tetanus proper—tetanus of the new-born, as it is called—and which is one of the most serious diseases which may threaten the new life on its threshold. It is generally excited by inflammation of the navel-cord, which is usually the result of neglect and uncleanness, especially if the child be in a hot climate. These conditions are often found united in regard to the negro babies of the Southern States, and hence, among them, tetanus is not unfrequent. It is quite analogous to the tetanus of wounded soldiers.

A few days after birth the mother will notice that the child is unable to nurse, cries when the nipple is placed in the mouth, does not close its lips upon it. Upon closer examination it will be found that the jaws are stiff; that the child cannot move them. In a little while attacks as of trembling will come on, in which the four limbs are thrown out and become rigid; then the whole body

is bent backward like a bow. After a few seconds of these painful contractions, the stiffened muscles relax, there is a long, deep sigh, showing that the lungs fill with air. But the least jar or movement of the body will bring on the spasms again, and the poor baby finally dies either of exhaustion or because spasm of the chest muscles renders breathing impossible. Life is rarely prolonged more than two or three days, and sometimes terminates in a few hours.

Tetanus is a disease involving some kind of alteration of the spinal cord, though precisely what this may be, physicians have not, as yet, determined. It is clear, however, that the ends of the nerves lying in the wound—in the case of the new-born baby, in the wound at the navel—are intensely irritated by the inflammation; and the irritation travels up the nerve to the spinal cord, to be diffused throughout it and to the roots of all the nerves given off from it. This irritation is then reflected back to the muscles all over the body, throwing them into the spasms described.

Treatment.—The most important part of the treatment is preventive, especially by means of such care of the navel-cord as shall arrest its inflammation. If convulsions once begin, they nearly always progress to a fatal issue. The remedy which has had the most success in arresting the disease is Chloral.

Non-Congenital Diseases.

It is evident, from the nature of the case, that all congenital diseases of nervous organs must be organic—that is, must be connected with tangible alterations of nerve-tissue. But in diseases arising subsequent to birth, the first classification relates to this very point; and these diseases are divided into the two classes of *organic* and *functional* diseases.

It is an important circumstance about organic diseases of the nervous system, that they are all dangerous, and nearly all fatal to life, or at least incurable. This is not the case with organic diseases of other parts of the body. Thus in pneumonia, or inflammation of the lung, the structure of the lung is very extensively altered; nevertheless recovery is to be expected in the great majority of cases. But inflammation of the brain is one of the most dangerous of diseases, and, as occurring in children, almost invariably fatal. The first important question to ask, therefore, when a sick child suffers from nervous symptoms is, whether these indicate organic or functional disease of the nervous system. Organic diseases of this nervous system are divided into cerebral, affecting the brain, and spinal, involving the spinal cord.

Many diseases that, to the uninformed observer, would seem to be located in the limbs, their muscles or nerves, really depend upon alterations of certain portions of the spinal cord from which these nerves come.

Beginning with diseases of the brain, we are at once led into a third classification, or division into those diseases which are attended by fever and those which are not. Brain diseases with fever are all more or less acute; diseases without fever are *usually* chronic, some lasting for years. But while all the febrile diseases are acute, all acute diseases are not febrile ; and this, therefore, leads to a fourth classification, which only applies to the acute diseases, namely, into those which have fever, and those in which there is no real rise of temperature of the body, even though the patient may seem "feverish."

Brain Fever—Meningitis.

Acute cerebral diseases, accompanied by fever, are all *inflammations.* They constitute in fact the class of diseases which are popularly grouped together under a single name—*brain fever.* This term, however, might be applied to three distinct kinds of inflammation. The first, called *simple meningitis*, is an inflammation of the membranes enclosing the brain, and of the most superficial layer of brain tissue immediately beneath them. This simple inflammation generally occupies the convex surface of the brain, or top, just underneath the roof of the skull. It is comparatively rare in children, especially in children under three or four years of age.

In the second kind of meningitis the inflammation is accompanied by the formation of tubercles along the blood-vessels. These tubercles are minute semi-transparent bodies, about the size of a pin's head. They cannot be considered dangerous in themselves, but as an indication of a special form of inflammation attended with constantly progressing destruction of tissue. The disease always begins at the base of the brain, and hence is often known as *basilar meningitis.* When emphasis is laid upon the presence of tubercles, rather than upon the anatomical seat of the inflammation, it is called *tubercular meningitis.* It is much the most frequent form of cerebral inflammation in young children. It has even been asserted that whenever an inflammation of the brain in a child lasts a little while, it becomes complicated by tubercles, even where these have not existed at the outset.

There is one variety of the tubercular meningitis, which is characterized by an unusually large effusion of serous fluid into

the cavities of the brain and underneath its investing membranes. In this case, if the fontanelles are still open, and the child's head yielding, the bones may be pushed apart by the accumulation of fluid, and in the course of a few weeks the head may become considerably increased in size. The disease is then called *acute hydrocephalus*, or the acute form of *water on the brain.* This is not a distinct disease.

The third form of meningitis is radically different from the other two. It is an epidemic disease, analogous to typhus fever, has often been called *spotted fever*, or *spotted typhus*, but its modern name is *cerebro-spinal meningitis.* In this disease the inflammation is very intense and acute, sometimes running its course in a day or two toward a fatal termination. It occupies the base of the brain and medulla, and extends to a greater or less distance along the spinal cord. But although this disease may be so fatal, nevertheless the chances of recovery from it are, on the average, much greater than from the other forms of cerebral inflammation. The mortality varies in different epidemics, and although sometimes eighty or ninety persons die out of every one hundred attacked, yet sometimes seventy-five of every one hundred recover, while the chances of recovery from tubercular meningitis, or "water on the brain," are infinitesimally small.

Cerebro-spinal meningitis is not a disease peculiar to childhood, as is water on the brain, nor even does it occur most frequently at this peroid of life, as does tubercular meningitis. It attacks all ages indiscriminately, but most frequently young people between the ages of fifteen and twenty-five. [See chapter on Acute Infectious Diseases.]

Symptoms of Inflammation of the Brain.

Symptoms of inflammation of the brain depend partly on the seat of the disease and partly on its nature. The most dangerous form, the *tubercular meningitis,* is that which begins in the most insidious and least alarming manner. For several weeks the child will seem languid and feverish without assignable cause. The appetite may remain pretty fair, and the bowels show no disturbance either in the way of constipation or of diarrhœa. Occasionally, however, an attack of vomiting will occur without apparent cause. Often many days will elapse before it is repeated; but the child grows pale, loses flesh and strength, becomes disinclined for exertion or his ordinary play, is often ready to lie down and go to sleep, but sleeps badly—starting and moaning—often rolling his head on the pillow, or grinding his teeth. The head is

habitually hot, or subject to hot flushes. One cheek is sometimes flushed, the other pale. There may be so little fever as to escape ordinary observation, but a thermometer placed in the bowel will discover irregular variations of temperature. The correct temperature of the bowel is 100° Fahr. or a little below. In the condition we are describing, the thermometer stands habitually at 100.5° Fahr. or 101° Fahr., and rises irregularly to 102° Fahr. or 102.5° Fahr. If it reach 103° the skin of the child generally feels warm, and he is supposed by his mother or attendants to have fever.

One of the most important symptoms at this stage of the disease is the pulse. It is, in spite of the slight fever and the frequent irritability of the patient, generally not accelerated, often rather slower than usual for the age. When the temperature is 102° and the pulse 80 in a child, trouble may always be suspected in the brain; for it is characteristic of all brain diseases (in general) to make the pulse slow, and this in spite of other conditions —as fever—which habitually render it quick. Another important change in the pulse, that always occurs sooner or later in brain fever, is its intermittence; that is, the pulse will go on regularly for ten, fifteen, or twenty beats, and then stop for a second, then resume. The child, of course, is quite unconscious of this symptom, nor would it usually be discovered except by a physician.

As the disease advances, the child, if old enough, will complain of headache. Younger children show suffering in the head with almost as much precision by the expression of the face. When a child has pain in the chest or the belly, the middle or lower part of the face is contracted. But when the pain is in the head, it is indicated by a frown between the eyebrows and an evident shrinking from the light; sometimes by uneasy movements of the little hands to the head, as if to draw out the source of the suffering.

It is the early symptoms of this insidious disease which are of the most importance, because, if ever the child is to be saved from the impending danger, it is at this time. The symptoms above described all depend on alterations in the circulation of the brain —species of congestions—which, so long as no other change has occurred, are not insusceptible of cure. It has often been disputed whether the tubercles which give the fatal stamp to the disease are formed first, and then, by irritation, excite the congestion, or whether they are only formed after the congestion has lasted a little while. It is probable that the tubercles are sometimes formed before the congestion sets in, and sometimes after. In the first case the disease is probably incurable from the beginning; but in the second case it is often possible to dissipate the congestion be-

fore the substance of the brain itself has become softened. If this can be done the child's life is saved, at all events for the time being. This precious moment, however, is too often allowed to slip by, because the symptoms marking the onset of the disease are mistaken for those of intermittent fever, or, even more frequently, for worms. Two simple considerations should always be kept in mind in relation to these suppositions. If the child is really suffering from worms, the administration of a worm powder, as Santonin or Wormseed,* will bring them away. If no worms are expelled after sufficient doses of such a remedy, there is not the slightest reason for continuing to suspect their presence. On the other hand, if the child has intermittent fever, there will be some part of every day when the thermometer in the bowel will mark a really normal temperature (100° F.), while in meningitis, the fever, however slight, is nearly constant. Moreover, in intermittent fever the fever paroxysm is always higher than is habitual in the first stage of meningitis ; the temperature ranges from 103° to 106°, when the fever sets in ; this is equally true of so-called remittent fever, really typhoid.

Prevention.—The children the most liable to tubercular meningitis are those belonging to consumptive families. Tubercle of the brain entirely resembles tubercle in the lungs and bowels, and brain fever is one form of general tuberculosis. Hence, parents, who have lost one child of "brain fever" in early infancy, are called upon to watch over others with double solicitude, in order to guard not only against the occurrence of brain disease, but also of pulmonary consumption.

It is children thus unfortunately predisposed who are the most liable to be injured by premature or excessive schooling. Blood is brought to the brain in excess by mental exertion, or accumulated there by prolonged sedentary confinement ; the blood-vessels are too weak to bear the pressure, congestion sets in, then exudations of albuminous fluid along the vessels, which results in the formation of tubercles. Hence it is not unfrequent that a delicate child who, by care, has been maintained in tolerable health until the age of six or seven, is then deemed strong enough to go to school, but breaks down and dies in the course of the first year. Such children should never be sent to school, until ten or twelve years old, and indeed it is preferable to educate them at home until sixteen or seventeen, avoiding the emulation of large classes, the evils of non-ventilation, prolonged confinement, etc. But, of course, the task of remodelling the constitution must begin earlier

---

* See page 524.

than the earliest school age. It should begin at six weeks after birth, when the child must be taken from the breast of the mother and handed over to a healthy wet-nurse. By breast-nursing an invigorating effect is produced, not very dissimilar from that sought by transfusion of blood. The milk, secreted directly from the blood of the nurse at the moment the baby puts its mouth to the nipple, passes warm and living to the baby's stomach and bowels, and thence, the fat globules at least, almost as directly into its blood. These fat or milk globules, contain the butter, but are not to be considered merely as masses of butter, but rather as particles of living matter, which may be thus transplanted from a vigorous to a fragile organism, and, in the latter, give an impulse to vigorous development of all the tissues in which the blood, carrying the milk, circulates. Children of tuberculous, *i. e.*, consumptive families, should be kept at the breast for a year. Afterward, the food, though nutritious, should not consist too largely of meat. Meat should be only gradually introduced into the diet during the second year; given at first only in the form of soup, then of meat-juice, then of finely scraped rare meat. Under two years of age, one meal of meat a day is sufficient. Constitutions with a tendency to the formation of tubercle are less able to digest and assimilate albuminous material; and it is the opinion of some observers that tubercle, which is a highly albuminous substance, represents an excess of albumen which is left circulating in the blood, because non-assimilated. This is the reason why abundance of meat, which is the most concentrated form of albuminous food, will often deteriorate the very constitutions it is expected to invigorate. Potatoes, on the other hand, and most vegetables, are deficient in nutriment, because containing too much water. Milk and bread, oatmeal, barley and farina are the best articles for food at meals from which meat is excluded.

Constant life in the open air; daily cold bathing; as often as possible, visits to the sea-coast: these are all hygienic measures of the highest importance and of real efficacy in warding off a disease whose real invasion, once begun, is too often irresistible. Finally, cod-liver oil, and the hypophosphites of lime and soda may be given for months at a time, every winter at least, so soon as the child begins to droop. These medicines are decidedly powerful in correcting the perverted nutrition upon which the formation of tubercle depends. They are, hence, important remedies in regard to any form of tubercular disease; but they have a special influence upon the nutrition of the nerve tissues, which is of great importance in the disease we are considering. When the nutrition of the nerve tissues in the brain is active, they are able to appro-

priate the blood that is brought to them as fast as it comes ; but if their nutrition is languid, the blood is not taken up, remains in the blood-vessels, distending them, and thus permitting the much-to-be-dreaded congestion. Hence, cod-liver oil and lime-salts, by improving the nutrition of nerve-tissues, directly diminish the liability to their passive congestion.

Treatment.—Direct means of acting upon these congestions, by the influence of remedies which are capable of contracting blood-vessels, and can only be used when congestion is actually present, cannot be used in prevention. Their employment constitutes the treatment of meningitis itself, and must be in the hands of the physician. Of these remedies, quinine in *large* doses (*i. e.*, twenty grains a day), ergot, digitalis, and ice are the most powerful. To be of use, these medicines must be given during the stage of the premonitory symptoms, the stage, which, as we have said, is so liable to be confounded with worms or with malarial fever, and before there has been any effusion of serum or pus into the delicate tissues of the brain, destroying them irrecoverably. This same great indication (contraction of the dilated blood-vessels in the brain) is the keynote to the treatment of the other forms of cerebral inflammation to which we have alluded.

Simple Congestion of the Brain

The symptoms of simple acute congestion of the brain can often not be distinguished from those of acute inflammation. The four great remedies, already mentioned—quinine, ergot, digitalis, ice—do unquestionably often cut short an impending inflammation, as indicated by fever, headache, delirium, convulsions, and vomiting. The chances of success are very much in proportion to the freedom of the constitution from tubercular tendencies. Such cerebral congestions are often the result of a disordered digestion of the stomach or bowels, and it is always proper to begin treatment by a purgative, either calomel or castor oil. This has the double effect of removing any substance which may be a source of irritation, and also of acting as a "revulsive," that is, of turning blood from the head to the vascular reservoirs of the abdomen.

Rachitic Congestion of the Brain.

Another and less dangerous cause than tubercle from cerebral congestion is rickets of the head. Rickets (as will be described in another part of this book) is a disease affecting the nutrition of

the bones, making them spongy, soft, and vascular. Under its influence the bones of the legs become curved, giving rise (when the curvature is in excess) to the deformity known as bandy legs ; and the head flattens out, becoming very broad, with bulging forehead. The fontanelle is late in closing, and all the bones, as well as the membranes which cover the brain, have more blood in them than is healthy.

A watery fluid sometimes exudes from the blood-vessels of the skull upon the surface of the brain. Since the blood-vessels of the membranes of the brain are liable to be passively distended at the same time, there may be coincident exudation into the cavities of the brain, thus causing pressure from within outward, as well as from without inwards. The pressure of this fluid upon the brain irritates it, and may occasion many of the symptoms of congestion already described. Generally these symptoms are not so severe as in the other cases, and a tendency to drowsiness and torpor is early shown—sometimes at the very beginning.

Treatment.—It is in these cases that great benefit may often be derived from a fifth remedy, different from those mentioned ; namely, iodide of potassium. Under the influence of this drug, the effused fluid is often rapidly reabsorbed and the child recovers, apparently at the very moment when a fatal stupor seems about to set in. Iodide of potassium is also of great use in the treatment of the epidemic, or cerebro-spinal meningitis, which is characterized by the very rapid formation of pus at the base of the brain and at the upper part of the spinal cord. Iodide of potassium is a medicine which seems able to cause the reabsorption of such exudations, and it has been shown to have, besides, a special affinity of action upon the upper part of the spinal cord, the principal seat of disease in cerebro-spinal meningitis. Finally, when liquid effusion has taken place in the head under the influence of rickets, and without the formation of tubercles, digitalis is a remedy of old repute, and which sometimes seems to really arrest the progress of the disease. It will certainly fail, like everything else, in tubercular meningitis or hydrocephalus.

Spurious Hydrocephalus.

We should not leave the question of inflammation of the brain without mentioning a condition which may sometimes be mistaken for it. This occurs in children who have been greatly debilitated from any cause, especially exhausting diarrhœa or cholera-infantum. Owing to the debility, the action of the heart becomes feeble, and, owing to the draining off of water from the blood by the dis-

charges from the bowels, the blood becomes thick and viscid. These two conditions together render the circulation everywhere imperfect, and especially in the brain. So little blood is sent to the brain that the fontanelle sinks inward. The face becomes pale, sometimes bluish and cold ; the child lies in an apathetic, stupid condition, the pulse and respiration growing always more feeble. Finally the blood begins to coagulate in the great veins of the brain, the child falls into convulsions or sinks into a stupor, from which it is only aroused by an attack of convulsions—the immediate forerunner of death.

Nothing can more certainly render this dangerous condition fatal than treatment of it as an active inflammation ; yet the mistake has not unfrequently been made. Powerful stimulation alone can save the child : brandy, ether, musk, the hot mustard-baths, the administration of iced-milk, or beef-tea in small quantities. Such means, adopted in time and with judgment, will often rescue an unfortunate baby from the very brink of the grave. This pseudo- or false-meningitis, as it is called, is an extremely acute disease, running its course, sometimes, in twelve hours. But it differs from the other acute diseases we have described in the absence of fever. Indeed the temperature of the body constantly tends to fall below the healthy standard.

Bleeding, or Hemorrhage into the Brain.

There is another acute cerebral disease, or rather accident, not peculiar to childhood, but from which children are by no means exempt, which, also, is free from fever. This accident is hemorrhage into the brain, giving rise to the group of symptoms known as *apoplexy.* It is the new-born child—like the old man—who is the most liable to apoplexy, the hemorrhage taking place at the moment of birth, when the head is subjected to undue pressure. In old persons the hemorrhage takes place into the substance of the brain ; but in new-born children the blood is poured out on the surface of the brain, just underneath its enclosing membranes. Such children are often said to be asphyxiated ; they do not breathe, or are made to do so with difficulty ; often remain for several days in a species of stupor, during which, finally, they not unfrequently succumb. But recovery, also, is not unusual, the blood being reabsorbed, and the brain sustaining little injury from pressure, on account of the yielding of its unclosed bony case.

Hemorrhages, occurring in later infancy or childhood, resemble much more those of middle life and old age. As the head has become solidly closed and unyielding, the soft brain has

no way of escape from the pressure to which it is subjected when a blood-vessel breaks and blood is poured out upon it. Its tissues are, therefore, compressed, and their function abolished; that is, the child loses consciousness and falls in a real fit of apoplexy. From the time the fontanelle is closed, that is, from the time the child is fifteen or eighteen months old, the hemorrhage is more likely to take place *into* the brain than on its surface, as was at first the case. Hence, after the attack of apoplexy has passed over, the child is liable to remain paralyzed on one side of the body, because a portion of nerve-substance on the other side of the brain has been destroyed by the hemorrhage into it.

Treatment.—Thus, although the accident is acute and unpreventable—because impossible to foresee—its consequences constitute an extremely chronic disease. The only treatment for the paralyzed limbs consists in applications of electricity; in massage or systematic rubbing; in passive gymnastics; in the hot and cold douche. These means sustain the nutrition of the nerves and muscles of the limbs until, if ever, the tissues in the brain can recover from the injury which has been inflicted upon them, when voluntary motion may finally be restored.

There remain to be mentioned two other diseases of the brain, essentially chronic in their nature.

Tumors of the Brain.

Tumors may form in the brain, giving rise to the most (apparently) strange symptoms. One of the first and the most prominent is staggering in the gait, with a tendency to fall, sometimes always forward, sometimes always backward: the child seems to be drunk. There is frequent vomiting, as in all brain diseases in children. The sense of sight is generally diminished, sometimes in one eye, sometimes in both, and quite lost before the fatal termination of the disease. Sometimes the sense of hearing is lost; sometimes the eyes become very prominent, thus giving a very strange expression to the face. The sense of touch and sensibility to pain are generally unimpaired. Muscular strength is quite preserved, so that there is no real paralysis, although the impossibility of controlling the movements makes the child appear paralyzed to the bystander; but this loss of control really more resembles that of St. Vitus' dance.

Headache is a symptom rarely absent in tumor of the brain, and the most distressing to the patient as well as to those who are compelled to witness his sufferings. Fortunately the duration of the disease is generally shorter in children than in adults.

We say fortunately, because, as the termination is invariably fatal, prolongation of life is only prolongation of useless pain. The only treatment is such as may palliate the pain, as opium, bromide of potassium, and ice.

Hardening or "Sclerosis" of the Brain.

Finally, one rare disease of the brain deserves mention. It is an induration, partial or general, dependent upon a growth of fibrous tissue in the brain. This sometimes leads to an apparent hypertrophy or enlargement of the brain; but this is only apparent, for the nerve-tissue proper is really atrophied or destroyed by the fibrous tissue which is substituted for it. When the disease is generalized throughout the brain, the principal symptom is a constantly increasing drowsiness, in which the patient's life is gradually and painlessly extinguished.

Diseases of the Spinal Cord.

Of the acute organic diseases of the spinal cord we have already mentioned cerebro-spinal meningitis, in which the inflammation extends from the base of the brain more or less completely along the whole spinal cord. Besides this epidemic inflammation, there is another, where the disease is situated, not in the membranes covering the spinal cord, but in the very substance of the cord itself.

Acute Inflammation of the Spinal Cord.

There is a rare form of such inflammation, more often seen in adults than in children, but still occasionally in them, where an acute inflammation runs rapidly up the centre of the cord, destroying the column of gray nerve-tissue upon which its most important functions depend. The patient is paralyzed, first in the lower limbs, then the upper, and finally dies by paralysis of respiration. The duration of the disease is from a few days to a few weeks, and its termination is always fatal.

Infantile Paralysis.

There is another form of acute inflammation of the spinal cord much more frequent in children than the foregoing. It occasions a sudden paralysis of a few muscles, or of a limb, or even of two limbs, which is followed by a remarkable wasting away. This

accident is liable to occur while children are teething, and is very often attributed to the irritation of swollen gums.

Sometimes this paralysis comes on in the course of an ordinary febrile disease, as measles or scarlet fever; sometimes it is preceded by a day or two of feverishness, apparently without cause. Sometimes a child, who has been put to bed at night in good health, wakes up in the morning with a paralyzed limb. The paralysis is generally in the lower limbs, most often in one, occasionally in both. There is no pain and, at first, no visible change in the little leg that has begun to hang helpless. But in a week or two it begins to feel colder to the touch, and at the same time to grow smaller than the other. The wasting progresses very rapidly, and in a few weeks the limb has become so shrunken and flaccid that it scarcely seems part of the child's body, which, elsewhere, retains its plumpness and roundness. The French have called such paralyzed legs *jambes de Polichinelle.* The muscles do not contract, even to electricity.

When no improvement occurs, the leg remains permanently helpless, seeming to get more and more withered as the stature of the child increases. The paralyzed limb grows somewhat, but always remains very much smaller than its healthy fellow.

More often, fortunately, the greater part of the muscles of the limb recover themselves spontaneously, and only two or three are permanently paralyzed. In this case the limb grows pretty well, and can be used more or less perfectly, especially if the action of the paralyzed muscles be supplemented by rubber bands, according to ingenious contrivances recently introduced.

Finally, it is possible that a complete recovery take place, and all signs of paralysis disappear. This may even happen spontaneously without the intervention of medical aid. But the early resort to certain remedial measures is of very great importance, for, unlike the cases of hopeless disease of which we have had, unfortunately, so much to say, in this the chances of recovery are very much influenced by treatment, provided this be at once prompt and judicious.

The paralysis depends, as we have already implied, upon an acute inflammation of the spinal cord. This inflammation is limited to a very small portion of the cord—to the anterior part of the central column of gray matter to the part—that in which originate the motor roots of nerves. (See page 78.) Reference to the section on Anatomy will remind the reader that these roots pass to groups of large nerve-cells containing many prolongations, each of which is connected with a delicate nerve filament. Although the impulse for voluntary movements comes from the brain, it

requires to be reinforced by impulses originating in these groups of spinal cells in order to become effective. When, through this acute inflammation, the spinal cells are destroyed, the motor impulses from the brain are unable to make the muscles contract.

It is not probable, when these nerve-cells have once been destroyed, that they are ever formed again, and hence all the nerves connected with them must remain paralyzed. But, at the beginning, a large number of cells are temporarily affected by the inflammation, while only a small number are completely destroyed. The first recover, and with them a large number of nerves; and this is why a paralysis, at first involving a whole limb, afterward becomes limited to a single group of muscles in it. But besides this, spontaneously or under the influence of treatment, other nerve-fibres are enabled to more or less supply the place of those which are paralyzed, and other muscles to perform, more or less perfectly, the work of those which remain helpless. On both accounts, therefore, there is a tendency to partial recovery from the paralysis.

Treatment.—This tendency to recovery may be helped by two kinds of treatment. The first is directed to allaying the congestion in the spinal cord. The principal remedies for this purpose are: ice externally, applied over the back, and ergot internally. This medicine has a very great influence over spinal cord congestion.

The second half of the treatment is intended to keep up the nourishment of the nerves and muscles, and to prevent, as much as possible, the latter from wasting. This consists in the application of electricity, at first in the form of galvanism, afterward the so-called magnetic or Faradaic electricity. It is very probable that the application of electricity along the nerves helps to bring into play new nerve-fibres to take the place of those which have been paralyzed. Systematic rubbing of the paralyzed limbs is also very useful, and can readily be performed by the mother or nurse.

The treatment with ice and ergot is only useful during the few weeks immediately following the occurrence of the paralysis. The applications of electricity and the rubbing must be kept up for months and even for years. Finally, when it becomes evident that no further improvement is obtainable, it is possible to adjust certain apparatuses to the paralyzed leg so as to hold it in position, and enable the child to stand and walk.

Hardening, or "Sclerosis" of the Spinal Cord.

Besides these forms of motor paralysis, children are liable to another kind—equally painless—depending upon disease in a somewhat different part of the spinal cord. By reference to the anatomical description the reader will remember that in front and at the sides of the central gray column of the spinal cord, containing cells, there are white columns composed exclusively of fibres. Some of these come from the cells in the gray centre; some, from the brain; all are destined to carry motor impulses, without which the muscles cannot be moved. In the disease of which we are now speaking, certain patches of these fibres degenerate and waste away. Their place is supplied by a fibrous tissue destitute of nerves, harder than the rest of the cord, and interrupting the transmission of motor impulses as effectually as a piece of slate inserted in a telegraph wire would interrupt the transmission of the message. It is on account of the greater hardness of these diseased patches that they are said to be "sclerosed"—this word coming from a Greek word signifying induration.

The principal symptom of this form of myelitis or inflammation of the spinal cord consists in a gradual but constantly increasing weakness and loss of power in the legs. If the disease is unchecked, these finally become entirely paralyzed; but, as in the cases mentioned, the child suffers no pain.

Paralysis from Rickets.

This disease is sometimes confounded with another, which is much less dangerous. We have already had occasion to speak of rickets, a disease in which the bones remain preternaturally soft, and become bent under the weight of the body. The bones of the legs are very often affected, the child becoming "bandy-legged" in consequence. While the bones are soft they are often so tender that walking causes pain. The child, therefore, refuses to walk, and may thus appear to be paralyzed, although not so in reality.

Rickets may also involve the spinal column, and induce an appearance of paralysis in another way. The bones of the spinal column are separated from each other by little elastic cushions of a peculiar gristle-like substance. These cushions are called the intervertebral disks, and are of great importance in maintaining the flexibility of the spinal column, and enabling it to sustain the weight of the body. Now it sometimes happens in rickety chil-

dren that these disks become softened. Too much weight then comes upon the bones: they give way, the back becomes bent outward, instead of in the regular natural curves, and the child may become quite unable to walk. Such cases are often very rapidly relieved when the weak back is supported by a plaster-of-Paris jacket, and the constitution is strengthened by cod-liver oil, iron, and phosphate of lime.

Functional Diseases.

We may now turn from the somewhat gloomy picture of the organic diseases of the nervous system, and consider another class, equally large, but far less serious, in which, notwithstanding violent nervous symptoms, the structure of nerve-tissues is not altered. This class of diseases is called functional, because the functions or actions of the nervous system are suspended or perverted, although there is no organic disease.

We may divide these diseases into two classes, according as they belong to the brain or nerves coming from it, or to the spinal cord and its nerves.

Paralysis of the Muscles of the Face.

The first and simplest among the functional diseases of the brain is a paralysis of the nerve going to the muscles on one side of the face. This paralysis is often caused by cold, and is not extremely rare in children from five to twelve years of age. Possibly the irritation of the second teething may sometimes be a cause of it. The paralysis is generally observed in the morning when the child first awakens. The face is drawn to one side—that not paralyzed—because on this side the muscles retain their strength, while on the other side all power is lost. On the paralyzed side the corner of the mouth drops, the eyelid stares wide open, and the whole face seems flattened and expressionless. The staring open of the eye is peculiar to this kind of facial paralysis, and does not occur in paralysis caused by disease of the brain, when the arm and leg are paralyzed also. This accident is very alarming in appearance, but recovery is usually quite speedily obtained by the use of Faradaic electricity. Sometimes recovery is spontaneous, but then usually only after five or six weeks, while under electrical treatment the child may be quite well in a week or two.

Paralysis of the Palate.

The nerves going from the brain to the palate are sometimes paralyzed after diphtheria. In health, during the act of swallowing, the soft palate, which forms the roof of the mouth behind, rises like a curtain and prevents the food from passing into the back part of the nostrils. Now if the muscles which raise this valve-like curtain, be rendered unable to move, on account of paralysis of their nerves, the curtain flaps idly at the moment of swallowing, the food is not guided into the throat, but regurgitates through the nose; or it even falls into the larynx, and causes spasms of choking, which are occasionally fatal.

The first **symptom** of this paralysis is a nasal twang to the voice in speaking; the child "speaks through the nose," at the same time swallowing, especially of liquids, becomes painful and troublesome. The paralysis comes on during convalescence from diphtheria, sometimes when the child is supposed to be quite well. It is much the most frequent paralysis observed after diphtheria, and affects the parts which have been the seat of the local disease. Sometimes it is accompanied by paralyses of muscles in various parts of the body, scattered irregularly.

Treatment.—These paralyses almost invariably disappear in the course of from one to six weeks. Recovery is much aided by the general tonic treatment adapted to convalescence from diphtheria, and more especially by the administration of small doses of strychnine. Electricity is also useful, but its effect is not as marked in this form of paralysis as in the paralysis of the face from cold.

False Croup—Spasm of the Glottis.

The three other nervous diseases which affect nerves coming from the brain are not paralytic, but spasmodic, convulsive. The first of these is known as crowing inspiration, or spasm of the glottis; it is even ranked among those anomalous disorders called by nurses "inward fits." It consists in a sudden spasm of the muscles of the larynx, whereby the opening to the windpipe is closed and the entrance of air to the lungs rendered impossible. The child, without previous warning; without cough or convulsion, suddenly stops breathing, and in a few seconds grows quite dark in the face. At the moment, however, that suffocation appears inevitable, the spasm relaxes, air is drawn into the lungs through the chink of the glottis, with a long, whistling sound,

owing to the rigidity of the vocal cords; the alarming livid color disappears from the face, the natural rosy hue returns, and the attack is over for the time. The frequency with which these attacks occur, as also the length of time to which the child may remain liable to them, are extremely variable. They are most apt to occur at the moment of awaking from sleep, especially at the beginning of the disease, when they only come on at rare intervals. But gradually they begin to be excited by fretting, crying, coughing, swallowing, sudden impressions of cold, and they grow more and more frequent, even as many as twenty or thirty attacks having been noticed in a day. The child may die in the first attack, or else struggle during several weeks or months, and finally succumb. The usual duration is several months, and more than half the cases (57 per cent., according to one authority) recover.

Causes.—This distressing affection has been attributed to a variety of causes. Nearly all the explanations which have been given suppose pressure upon, and consequent irritation of, the nerves going to the windpipe, on account of which the muscles of the larynx supplied by these nerves are thrown into spasms. The pressure has been supposed to be exercised by the enlargement of one or the other of the glands of the neck. Recently it has been shown that the children affected by this disease are generally rickety, and more especially that under the influence of rickets the bones of the head have become softened in one or more places, so that the finger can depress them like parchment. Whenever, therefore, the head rests upon the pillow, the brain is subjected to a pressure, from which, in healthy conditions, it is carefully preserved, and which it is not adapted to bear. The irritation of such pressure is reflected outward along the nerves of the larynx, which originate at the base of the brain, and, reaching the laryngeal muscles, throws them into a spasmodic contraction which prevents the entrance of air into the lungs.

When the brain is thus exposed to local irritation, all sources of irritation at a distance, as inflammation of the gums in teething, or disorders of the stomach and bowels, readily become exciting causes of the spasms, and bring them on when they would not occur from pressure on the brain alone.

Treatment.—The treatment of the disease embraces:

1st. Treatment of the constitutional rickets which may be present. This, as already noticed, demands the administration of cod-liver oil, lime, and iron.

2d. Free lancing of the gums if they are swollen and painful, and only then.

3d. Treatment of gastric or intestinal indigestion by careful regulation of the diet, and by appropriate remedies.

4th. Treatment of the paroxysms of suffocation themselves by sedatives. Bromide of potassium, chloral, and valerian are the most powerful medicines to be employed ; and the application of an ice-bag to the back of the neck or spine has been found useful both in averting and arresting the attacks.

Convulsions.

We have had occasion already many times to refer to convulsions, one of the most alarming and distressing accidents known to the nursery. On page 538 we have given, as far as is possible in these pages, an analysis of the manner in which convulsions are brought about, and the reason for their peculiar frequency in childhood. The description of a convulsive attack may be omitted, because it is familiar to all mothers.

Causes.—The causes of general convulsions, as of the special convulsive disease (spasm of the glottis), we have just been considering, must be divided into predisposing and exciting causes.

The first are :

1st. A deficient organization of the nervous system, resulting in that condition known as " a nervous constitution." This does not, as is often supposed, imply a predominance of nerve-force, or exaggerated nervous activity, but, on the contrary, an insufficiency of both. The nervous tissues offer deficient resistance to the various impressions made upon or conveyed to them. Every impression is thus converted into an excitement, an irritation. A person with this constitution is as little able to bear ordinary shocks as a portion of skin softened by a poultice is able to bear, without discomfort, an impression of cold. Other members of the family where convulsions are prevalent during infancy, often suffer from other nervous disorders.

2d. Rickets, the constitutional disease which undermines the nutrition of the bones and the muscles, profoundly weaken that of the nervous system also, and thus brings about that state of imperfect resistance to impressions which we have said so strongly predisposes to convulsions.

3d. In the same way any prolonged digestive disturbance—indigestion or diarrhœa—by impairing the nutrition of the nervous system, predisposes it to convulsions. In cholera infantum, or even in excessive watery diarrhœa, convulsions may be brought on by coagulation of blood in the great veins of the brain, as described on page 557.

Exciting causes of convulsions may be classified into: 1st, those which either greatly accelerate, or greatly impede the circulation of the brain; 2d, those which alter the composition of the blood; 3d, those which produce irritating impressions on nerves and are finally transmitted to the brain either directly or by the medium of the spinal cord.

1st. Among conditions impeding the circulation of the brain are the stagnation of blood in its veins from debility of the heart, interference with respiration, as in spasm of the glottis, croup, or even in extensive inflammations of the lungs; sometimes pressure upon the veins of the neck by scrofulous enlargement of its lymphatic glands. (Whooping-cough may also cause convulsions in this way.) The circulation of the brain is greatly accelerated in fevers, and hence these, not unfrequently, begin with convulsions. But at the same time the blood is altered, both by the fever poison and the high temperature, so that the causes of the convulsions are multiplied. An attack of convulsions, occurring every day or every other day at the same hour, may often take the place of an attack of chills and fever.

2d. A still more important alteration of the blood than that caused by fever, occurs when the action of the kidneys is suspended, and the impurities which they habitually eliminate from the blood are allowed to accumulate in it. During childhood the immense majority of cases of kidney-disease occur during or after the eruptive fevers, especially scarlet fever. In this disease a great number of children die in convulsions, after the fever has subsided, on account of the inflammation of the kidneys, which has insidiously established itself. Hence the necessity for frequent examination of the urine, and caution in exposure to cold during the convalescence from scarlet fever.

3d. Finally, inflammation of the gums or tonsils, worms, irritation of the stomach or bowels may all, in predisposed children, determine an attack of convulsions. The irritation caused by inflammation of the brain itself, or its membranes, is also an "irritation propagated from a distance," although a much shorter distance than in the first-mentioned cases. Since the parts of the brain in immediate contact with the inflamed membranes cannot in themselves originate convulsions, but an irritation must be sent from them to the medulla, at the base of the brain, which is the real starting-point of the convulsive disorder.

Treatment.—When a child is seized with a convulsion, it should be immediately plunged into a *hot-water bath*, to which, if there is time to procure it, mustard may be added. Cloths wet in cold water should be placed on the head while the body is immersed; or else

a stream of cold water allowed to fall on the head or on the chest from a pitcher. The last process is often very successful in restoring respiration, which is more or less suspended during the attack. Besides these measures, a few *drops* of *chloroform* may be poured upon a handkerchief and held over the nose and mouth. This remedy should be sent for at the moment of seizure, or kept on hand when the child is known to be liable to convulsions. By the time the attack, with its immediate danger, is over, a physician has usually been procured ; but if the mother, for any reason, be at a great distance from medical advice, she will do well to administer a teaspoonful of ipecac, in a cupful of water, as an *emetic* so soon as the child shall have completely recovered from the convulsion. Later, a large *enema* of soap and water should be thrown into the bowel.

Should there be recurrence of the attacks after these measures have been taken, the administration of *chloral,* in three to five grain doses, in half a wineglassful of cold water, to children over a year old, every three or four hours, will be indicated, no matter what other disease may begin to manifest itself as the cause of the convulsions. If, however, high fever set in, this may be presumed to be the cause, and the child should be immersed in cold water for five minutes, then rubbed gently in a blanket. The danger from convulsions is the principal *immediate* danger from a sudden rise of temperature in children, and should be combated by the application of cold.

Every woman should be familiar with the foregoing rules for meeting this terrible emergency, for, under the most favorable circumstances, it is impossible to summon a physician in time. The convulsive arrest of respiration can only last without interruption for a few seconds ; unless the patient is to die in it or to recover spontaneously, measures for relief must be taken instantly.

Epilepsy.

The epileptic convulsion does not differ in appearance from a single convulsion of the ordinary kind. The latter, however, is not unfrequently repeated at short intervals for a number of hours, so that the child is said "to be in convulsions" during that space of time. But in epilepsy, such a repetition only occurs in the most aggravated form of the disease, and often heralds a fatal termination. The important difference is, that epilepsy is a permanent disease of the nerve-centres, sometimes developed under the influence of some special irritation—more often spontaneously—as a consequence of congenital or hereditary predisposition.

This disease hardly belongs to early childhood, or, at all events, under six or seven years of age, but it is impossible to distinguish convulsions due to epilepsy from those depending on other causes. At the period of the second dentition, however, it is not unfrequent for epilepsy to manifest itself unmistakably. A sign of the disease, more characteristic than the convulsions, consists in the so-called "absences." The child loses consciousness completely for a few seconds or even minutes, the expression of his face becoming blank, while he is unable to see, hear, or speak rationally. He does not, however, fall, but sometimes utters some nonsensical exclamation and repeats the same automatically, like a machine, many times in succession. There are often automatic movements of the hands. Then consciousness returns, sometimes with a long-drawn sigh, sometimes unattended by any special phenomenon.

These curious attacks are quite characteristic of epilepsy. They are supposed to depend on the same cause as that to which loss of consciousness during the epileptic convulsion is attributed, namely, a spasmodic contraction of blood-vessels in the upper part of the brain, by which the parts of the brain whose function is thought, are suddenly deprived of nutrition and rendered incapable of action.

In the convulsive attack the irritation is transmitted to the medulla, as in other forms of convulsion; or, rather, this nerve-centre may be said to be in a chronic state of excitement, which is manifested from time to time in the "convulsive discharge." Children who have had convulsions in infancy do not seem to be more disposed than others to epilepsy in later years.

Epileptic attacks often come on at night, or early in the morning before the child has risen from bed. This is especially the case at the beginning of the disease, which thus may run on for months or even years without being discovered. The child may be found in the morning lying at the foot of the bed, or in some other strange position, and the clothes are nearly always wet from the involuntary discharge of urine that takes place at the close of the convulsion. If the tongue is found to be bitten, the presumption is strong in favor of nocturnal epilepsy.

The danger from epilepsy is entirely proportioned to the frequency of the attacks, either of convulsions or of "absences." When these occur only at long intervals, as six months or a year or even less, no perceptible effect will be noticed on either the body or mind of the patient. Indeed—as some illustrious historical examples testify—the existence of such a disease throughout a lifetime is not incompatible with brilliant intellectual development; but if the attacks recur frequently, the mind begins to be impaired, as is first shown by a failure of memory, constantly increasing.

On the whole, the occurrence of the disease in childhood is a more serious matter than in later life, for it is liable to increase in severity after puberty, and then the mental degeneracy advances rapidly, so that, by the age of twenty, the patient may be entirely imbecile. This, however, is by no means necessarily the case, since appropriate treatment will effect cures in a great number of instances.

The treatment must, of course, be in the hands of a physician, and, as is beginning to be popularly known, the principal medicinal agent upon which reliance can be placed, is bromide of potassium in large doses. The inconvenience of this remedy is its tendency to induce a state of apathy and stupidity which only substitutes one disease for another. This inconvenience may often be obviated by combining the bromide, in various proportions, with atropine and with strychnine.

But two agents of cure, of great importance, remain in the hands of the guardians of the patient, and depend entirely upon their care and perseverance for any success. The first of these is systematic open-air exercise ; the second is a milk and vegetable diet, to the rigid exclusion of meat. The latter method is often opposed by prejudices and preconceived notions, especially in the case of delicately built children that are supposed, above all things, to require "building up." There may, indeed, be cases in which this system may be shown by experience to be inapplicable, but a similar appeal to experience will confirm its efficacy in a great majority of cases. The indication is to maintain or improve the nutritive quality of the blood, while avoiding everything which may serve as stimulus to the nervous system. Meat, alcoholic beverages, tea and coffee, are to be rigorously avoided on account of this their stimulating effect.

Tetanie.

In the functional diseases of the nervous system there remains for us to consider the group whose manifestations are seated in the spinal cord, or the nerves emanating from it.

The first of these disorders which deserves mention is a curious affection which simulates, *in petto*, the serious organic disease already described as *tetanus:* hence a name, framed as a diminutive of the latter: *tetanie*. By some writers it is called *contraction of the extremities*, from the characteristic phenomenon of the disease. This consists in a rigid flexion of more or less of the four limbs. The thumbs are drawn down into the palms of the hands, the fingers are flexed at their junction with the palm of the hand, so as to conceal the thumbs, but the upper joints extended. The

hands are bent downward at the wrists, and sometimes the fore-arms are bent at the elbows; but this is rare. At the lower extremities the toes are bent, the feet stretched out rigidly. All the contracted muscles are hard, rigid to the touch, and are described as painful by children old enough to speak of their sensations. In marked distinction from tetanus, there is an absence of rigidity about the jaws or the muscles of the back: hence the emphasis laid on the fact that the disease is a contraction of the *extremities.*

The attacks of contraction are sometimes intermittent, lasting from a few minutes to an hour or two, each attack coming on once or twice a day. But if the disease is prolonged, the rigidity generally becomes persistent, lasting for weeks, with only slight remissions, then becomes intermittent again, when it begins to decline. It is often accompanied by the spasmodic disease we have described as *spasm of the glottis,* and is liable to occur under much the same circumstances as this. It is always important to distinguish between this idiopathic contraction and those which are symptomatic of organic brain or spinal disease. The diagnosis can only accurately be made by a physician; but the family may be guided by the following points of distinction: In inflammation of the brain the contractions are not confined to the extremities of the limbs; are permanent instead of intermittent, and are accompanied by fever, vomiting and constipation especially preceding the symptom of contraction. The reverse of all this is true in the idiopathic functional disease here spoken of.

Cause.—The cause of this singular and rather rare disease is an increased excitability or diminished power of resistance in the central gray matter in the spinal cord, analogous to that already described for the medulla, whose existence occasions convulsions, and, still more, to the excitability of the roots of the laryngeal nerves, which gives rise to spasm of the glottis.

Treatment.—The treatment is very similar to that of spasm of the glottis, as might be inferred from the analogy in the nature of the two diseases.

Removal of all known exciting causes, and the administration of the remedies already referred to, prolonged warm bath, valerian, assafœtida, musk, camphor, chloral, are the means best adapted to triumph over the disorder.

It is worthy of note that all the above remedies, except chloral, were formerly called "antispasmodics," but now are named "diffusible stimulants." The first name was derived from observation of their power over "spasmodic" diseases; the second was given when it was shown that such spasms implied deficient resistance of nerve-tissues rather than excessive activity, and that

these tissues therefore required *stimulants* which should be rapidly diffused throughout them.

Saint Vitus' Dance—Chorea.

Chorea is a very much more frequent disease than the preceding. It is characterized by irregular twitching and movements of various muscles occurring spontaneously, but always much aggravated during any attempt at voluntary movement on the part of the patient. These twitchings always involve the face, but are sometimes confined to one side of the body, or even one limb, especially the right arm. It is rare, however, that the disease remains so localized; it usually spreads to both sides, and involves all the muscles of the body.

It is most common about the age of the second dentition, being rare under six years of age. The intelligence is always affected. In the mildest cases the children show a great dislike to speak, and, in more severe cases, speech is rendered impossible by the violent contortions and spasms of the muscles of the face, whenever it is attempted.

Children who have ever had rheumatism are peculiarly liable to chorea, and, conversely, in a child once subject to chorea, attacks of rheumatism may be expected. Heart-disease, now known to be so frequent in the rheumatism of children, is also frequent in chorea, and, in cases that terminate fatally, is one of the most frequent causes of death.

Death, however, is rare, relatively to the frequency of the disease. But the condition of the child may become quite pitiable from the extreme helplessness to which he may be reduced: always unable to speak; to feed himself; to use his hands with any precision; often incapable of walking, or even standing; tossing incessantly on his bed, except when sleep induces a temporary calm. Sometimes, after the choreic movements have subsided, the child is left paralyzed on one half of his body, as if after an attack of apoplexy.

Chorea occurs, as has been said, in rheumatic children; also very readily in pallid, anæmic children, even without rheumatism; and finally, in those whose nervous system offers that congenital excitability from deficient resistance which constitutes the general substratum of nervous diseases in children. This may suffice, without anæmia, to determine the disease, in a child whose fleshy and rosy appearance leads bystanders to consider him as a model of health.

The prevention of chorea includes all the hygienic rules al-

ready given for increasing the tone of the nervous system—as cold bathing, open-air exercise, residence in the country, regular meals of simple food, abundant sleep, and avoidance of mental and moral excitement and prolonged hours of study. Among these rules, two are of extreme importance in warding off chorea : All sudden impressions, and especially fright, must carefully be guarded against. To a violent fright may often be attributed the first outbreak of an attack of St. Vitus' dance. Another great danger consists in the enforcement of rigid repose during school hours. The rules of the public schools are absolutely barbarous in this respect: a fixedly constrained attitude being exacted for hours, under threat of severe penalties, of young children who naturally tend to as much friskiness and gambols as do young colts.

The influence of these two causes, and especially the marked effect of moral excitement, already shows that chorea is not necessarily attended by any organic alteration of the spinal cord. It is supposed to depend on some functional alteration in the masses of ganglionic cells or centres situated at the base of the brain, from which motor impulses are sent to motor nerves and muscles. The effect on the intelligence, and also on the cerebral nerves going to the face, are partly explained by a cerebral origin for the disease, as they cannot be when the spinal cord alone is supposed to be involved. But we have placed chorea among the functional diseases of the cord, because the disturbance is propagated from the brain to the cord before reaching the nerves and muscles of the limbs.

Treatment.—A great many medicines have been used in the treatment of chorea, many of which are of little value. The best are : oxide of zinc, ergot and ice to the spine, when any tenderness can be detected by pressure along it ; finally, and much the best of all, arsenic. This is a remedy which rarely fails, but it must be given in constantly increasing doses, and for a period of at least two months. This is the period of average duration of the attack when left to itself ; and the child is rarely quite free from a tendency to twitching before that time, even when, under the influence of the arsenic, the more severe symptoms have been entirely subdued. The systematic employment of rhythmic gymnastic exercises is very useful, especially toward the close of the attack, to hasten convalescence, or, after recovery, to guard against a return.

Epidemic Chorea.

During the Middle Ages an extremely severe form of chorea several times prevailed as an epidemic, under the name of the

"dancing sickness." Whole troops of people—both children and adults—would be seized by this simultaneously, and parade the streets, throwing themselves into the most fantastic contortions. Such cases are occasionally seen at the present day in an isolated form, that is, a single child will be seized with a fit of uncontrollable and fantastic movements, dancing, climbing, jumping in an extraordinary and apparently impossible manner; but as the example is not imitated, the disease does not become epidemic. Such cases are called *chorea major*, or greater chorea, to distinguish them from the ordinary form, known, therefore, as *chorea minor*. This, however, is not the most extreme diminutive which is known. There is a form of choreic movement localized in a single muscle or group of muscles, sometimes in one of the limbs, much more frequently in the face, giving rise to rhythmic spasmodic contractions. Often the eyelids are affected, opening and shutting involuntarily at regular intervals, or merely twitching at irregular intervals. Sometimes the eyeball is rolled up or the eyebrows knit; sometimes the corner of the mouth is twitched to one side, or all the cheek drawn to one side in an ugly spasm. These movements are always aggravated during speaking, and often only occur at that time. Stammering is one form of choreic tic, the spasmodic movement being then confined to the muscles of articulation, distributed to the lips and tongue. This form of chorea is hardly seen in early childhood, but is very liable to come on at puberty. It is much more difficult to cure than the other—often, indeed, persists throughout life.

Treatment.—Gymnastic exercises of the affected muscles are more powerful means of cure than any medicines.

The name of *hemiplegia spastica* has been given to a condition in which rigid contractions of muscles occur, principally in the lower limbs, whenever the child attempts to use them. This disease has already been described on page 545. I have there pointed out that although it is apparently a functional disturbance of the muscles supplied by spinal nerves, it, in reality, depends on an organic alteration of the spinal cord, consequent on an organic disease of the brain, generally a hemorrhage which has taken place before, during, or shortly after birth.

Hysteria.

Hysteria, which is frequently considered a disease peculiar to the female sex, is still more widely supposed to be confined to adult life. There is no doubt, however, that it may occasionally manifest itself in a child. Hysteria in childhood may be mani-

fested by two classes of symptoms. On the one hand, children, and especially little girls destined in later life to become markedly hysterical, often exhibit a peculiar flightiness and excitability of temperament, violent and unreasonable temper, ready disposition to cry or scream on the least provocation, and are especially liable to the forms of digestive disturbances which torment adult hysterics. Among these, flatulence is the most frequent and noticeable, and its persistent recurrence in girls of nine or ten years of age—a period at which the digestion should be expected to be the most perfect—ought always to excite solicitude as a warning of future hysteria. Whimsical appetite, regurgitation of food immediately after swallowing and without nausea, sensations of sinking at the epigastrium, craving for food, of which only a few mouthfuls cause satiety or even disgust: these and other indications of nervous dyspepsia are to be dreaded, not only for their immediate influence on the nutrition, but as indications of an imperfection of the nervous system most liable to predispose to the serious disease in question. Headache, especially when seated on one side or in one temple, is another symptom, often, of hysterical significance. So, also, is a liability to pain in the left side under the heart, which is a neuralgia, or else seated in the muscles of the part. The perversions of sensibility in hysteria are generally seated on the left side of the body.

The second class of symptoms embrace such as are identical with various distinctly recognized hysterical manifestations of later life. Children rarely have hysterical convulsions; nevertheless, as the period of adolescence approaches, these may be observed. They may be distinguished from epileptic convulsions by the persistence of consciousness; by the constant agitation of the body, instead of the deadly stillness and rigidity of epilepsy, and by the screaming, laughing, and crying, which either accompany or follow the fit.

A more frequent hysterical symptom is that of excruciating pain occurring in various parts of the body. We have already mentioned hysterical headache. Besides this may be pain in the back, with tenderness on pressure; pains in the limbs simulating muscular rheumatism, or even following an attack of rheumatism, returning after the fever of the original disease has entirely subsided. Pains in the hip or knee are of especial importance, because often simulating inflammations of the joint. To establish the distinction sometimes taxes all the skill of an experienced physician; but all that is required for the treatment is radically different according as the pain is of inflammatory or of hysterical origin.

Instead of becoming painful, certain parts of the skin or subjacent muscles may lose altogether their capacity for feeling.

Not unfrequently one or more muscles become rigidly contracted, so that the limb is fixed in an unnatural position, and unable to move in obedience to the will. The rigidity often relaxes during sleep, and always under the influence of chloroform ; but otherwise it may persist for weeks, or even months, so that one arm is bent on the chest or one leg drawn up upon the belly.

Finally, instead of contraction rendering the limb useless, it may be rendered helpless by paralysis, then hanging loose and flaccid. It is a characteristic peculiarity of the paralysis, as well as of the rigidity due to hysteria, that it generally appears and disappears quite suddenly and without apparent cause.

From the foregoing remarks it is evident that we do not consider hysteria to be an "imaginary disease," or that the symptoms are "simulated" by the patient, even when, as is often the case, they may be cured by a powerful impression made upon the mind of the patient.

Hysteria depends on a perversion of function, or of nutrition, or both, of the elements of the central nervous organs—especially, there is reason to suppose, of the cells and net-work of finest fibres in the gray tissues. (See chapter on Anatomy.) As all nerves begin in these tissues, and as impulses to move muscles originate in them, and impressions from the skin and other distant parts must be brought to them before they are converted into sensations, it follows that disorder in the functional working of these tissues may cause disordered motor impulses to be sent down the nerves, determining the hysterical convulsions, or muscular contractions, and may pervert impressions brought up by nerves, so as to cause sensations of pain, when no external cause for pain existed. Again, the incoherent working of the cells in the masses of gray matter on the surface of the brain is the cause of the incoherence of mental action and moral feeling and of the instability so characteristic of the hysterical temperament ; and either this, or hindrance to the proper transmission of voluntary impulses along the conducting fibres of the nervous system, is the cause of the imperfect will-power, which is equally characteristic, and which often amounts to a real paralysis of the will.

Treatment.—It is for this reason that moral treatment is of such importance in the management of hysterical patients, and especially children. The moral instability characteristic of the disease is intensified by the instability characteristic of their age. The child's incoherent and capricious will requires to be braced up firmly by the strong, calm and perfectly even control of those

who are in charge of it. Weakness and irresolution in them is real cruelty—all the more so, because sheltered by the pretext of kindness and consideration. If, as too often happens, the mother of the child is herself hysterical, and thus unfitted to exercise the proper authority, her guardianship should be replaced by that of a stranger. It is often necessary to remove a child from home before an hysterical affection can be cured. The most distressing symptoms which had hitherto baffled all treatment, often yield like magic to the influence of new scenes and associations.

The most important medical treatment consists in the intelligent employment of electricity, and in the use of cold-water douches to the spine. The shower-bath may sometimes be substituted for the latter, but, whenever practicable, the full douche should be administered as the most potent means of cure. In the use of electricity it is important to select the Faradic or the galvanic electricity, according to the special indication. It is often useful to pass electrical currents down the spinal cord, either as a general remedy for the constitutional condition, or for the especial treatment of certain symptoms, as restlessness, sleeplessness, or pains in the back. For this purpose the galvanic battery, giving the so-called "constant current," must be employed, as well as in the treatment of the joint pains, and some other hysterical neuralgias. To restore sensibility to the skin, or sometimes, to remove a condition of excessive sensibility, and in the treatment of hysterical paralyses and contractions, the Faradic current may often be more serviceable.

Night-Terrors.

It is a well-known fact that the regular alternation of day and night coincides with rhythmic alterations in the nervous sensibilities of all animals endowed with highly organized nervous systems. The widely generalized habit among animals of falling asleep as soon as darkness comes on, and awaking with the return of day, might seem at first to contrast absolutely with the ability of human beings to sleep in the day and wake in the night whenever convenience demands. But in this respect, young children must be classed with the lower animals, rather than with adults of their own species, and in both young and old of the human race we find modifications of nerve states, which, if less absolute than the complete suspension of consciousness in sleep, are not less curious and interesting.

In the most general terms it may be said, that in the morning, motor force is at the greatest, while sensibility is then least;

and conversely, in the evening, when the power of moving and of muscular effort is least, the acuteness of feeling is the most intense. Associated with this increase of physical feeling is, necessarily, an increase of moral sensibility. Impressions, appreciated more keenly by the senses, more easily awaken emotions, and at the same time the power of resistance to impressions is diminished : first by the diminution of muscular force, and thus loss of power to escape when escape is suggested by terror ; and then by diminution in the power of reasoning, which accompanies this enforced passivity.

This heightened impressionability in adults is more often a source of pleasure than of pain, increasing the susceptibility to social intercourse, to music, to poetry, etc. But in children it is much more often a source of pain than pleasure, for the reason that it can only be experienced when some unnatural conditions have induced a state of sleeplessness at hours when, for children, sleep is the only normal condition. In them wakefulness beyond the accustomed hour for going to bed already indicates an irritable condition of the brain. A slight excess of irritability will cause the state of simple wakefulness to be complicated by attacks of screaming, or by delirium, or even by hallucinations, nearly always of a terrifying nature.

There is a considerable resemblance between these temporary hallucinations and those of delirium tremens. In both we observe a curious tendency to see small animals running about the room, on the walls or ceiling, dropping on the floor, running over the little patient's own body. The child then generally screams out loudly, and clings to its mother for protection. The appearance of these animals is, however, not always terrifying. The writer recalls one case of a little girl of extremely nervous temperament, where an attack of well-marked hallucinations attended convalescence from an acute gastric catarrh. During this illness a tolerably strict diet had been maintained, and the return to the usual regimen was gradual. On the evening of the second day after the amount of food habitual to health had been taken, the child became very much excited, though pleasurably so. She could not go to sleep, but chattered incessantly about birds of beautiful plumage that she saw flying around the room. This hallucination lasted during three or four hours and it returned on two successive evenings, though with diminished intensity and duration. It is almost superfluous to mention that, at this time, the child was entirely free from fever.

In such a case as this, the excitement was due to the stimulus of food, experienced by a brain naturally excitable, and at the moment enfeebled by abstinence. It is a general law, whose

appreciation is of the utmost importance, that whatever *weakens* any part of the nervous system, *increases its excitability*. This is because its power of resistance is weakened, and this is especially the case after privation of nourishing food, and therefore all impressions produce more effect; as a rock, when poised on a narrow support, may be thrown down by a touch, when the most powerful efforts could scarcely displace it from a stable equilibrium.

The first and most frequent cause of night-terrors in children is thus a condition which often causes great nervous irritability in the day-time, namely, an anæmic or badly nourished condition of the brain. The writer was recently consulted in regard to a little boy three and a half years of age, on account of the uncontrollable fits of screaming to which he was subject, and which occurred on the slightest provocation, or without any assignable cause. In this case, the screaming fits were much more common during the day-time than at night. The child was quite pale, but was considered healthy. It was observed that he passed a great deal of very clear urine. Inquiry elicited the fact that he had never been allowed to eat meat. The adoption of a mixed diet, including meat, together with the administration of iron, was followed in a fortnight by complete cessation of the attacks of screaming.

With nocturnal screaming, the condition of anæmia, which is often the remote cause of the attack, is usually complicated by a second and immediate cause. This is apt to be some temporary source of irritation, which, as already explained, acts so much the more potently as the nutrition of the brain is more imperfect. Indigestion is the most common source of such irritations. This may be caused either by articles of food absolutely unfit for any child at the age of the one in question, or relatively unfit for this particular child, on account of some enfeeblement of its digestion; or, finally, by food eaten too late at night. In any of these cases, the food may lie undigested in the stomach, irritating its lining membrane in such a way that impressions are sent from its nerves to the nerves controlling the blood-vessels of the brain. The latter nerves become temporarily paralyzed; as a consequence, the blood-vessels dilate, and too much blood flows through the brain. The nerve-tissues, in the case of habitual anæmia, having been accustomed to too little blood, are unable to bear this sudden change: first, sleep is broken; then terrifying ideas arise, and these originate hallucinations which the weak judgment and limited experience of a little child are unable to dispel. In the mildest form the terror is limited to the periods of falling asleep or of waking up; it then constitutes the so-called nightmare. But if the child be more susceptible, or the influence of the irritation be more prolonged or profound,

the terror is continued into moments of complete wakefulness. Even then, however, it is apt to be more intense on the borders of sleep; for, when apparently dispelled, it is constantly liable to recur as the little sufferer begins to doze into forgetfulness.

In the treatment of these night-terrors, it is of course first necessary to remove, as far as may be, the predisposing causes. The congenital or hereditary predisposition to nervousness must be combated by the means indicated elsewhere (see page 576); anæmia must be ascertained and corrected, and diet carefully regulated in respect to quality, quantity, and to the time of meals. It is a generally understood rule of hygiene that children should not eat late in the day, nor shortly before bed-time, and that their heaviest meal should be at noon, and not in the evening. It is, however, a bad plan to send a child hungry to bed; worst of all, to deprive him of supper as a punishment. An empty stomach and a brain craving for food will cause wakefulness and mental depression even more surely than will a full stomach and a brain temporarily congested by the irritation of a full stomach. Indeed, if it should be observed that the attack of terror habitually came on toward three or four o'clock in the morning, we should be led to infer that inanition was the cause rather than indigestion, as the latter produces its effects, preferably, before midnight. The remedy is then to give the child a light meal—bread and milk, or even a rusk, at eleven or twelve in the evening, waking him up for the purpose.

Exercise in the open air, pushed to the point of inducing healthy fatigue, is a powerful means of securing quiet sleep. So, also, a prolonged warm bath at night, especially when its sedative influence is followed by the tonic of a cold bath in the morning.

As directly remedial measures, a hot bath, with or without mustard, and given while a cold wet cloth envelops the child's head, is one of the best. When there is reason to suspect a full stomach of undigested food, an emetic * may be given with advantage. If the child has been constipated for a day or two, an enema of half a pint or a pint of soapsuds will often prove more tranquillizing than an opiate. As a direct sedative to the nervous tissue of the brain, bromide of potassium is the best. But it should only be used, if it prove necessary, after the measures above enumerated have been taken. It is well to give the bromide associated with lactucarium or extract of lettuce, and with orange-flower water †—

* [A half-teaspoonful of tincture of ipecac, or a couple of teaspoonfuls of the syrup, with one-third of a glass of water to a child a year old; or a teaspoonful of powdered alum or mustard-flour in half a glass of water.]

† [Eight grains of bromide of potassium, or bromide of ammonium, in two tablespoonfuls or more of cold water, or orange-flower water.]

anodynes of little value for the majority of adults, but of efficacy for the extremely sensitive organizations of young children, and also for such persons—chiefly women—as may resemble them.

Children subject to wakefulness, nightmare, or any form of nocturnal terror or excitement, should never be sent to sleep alone, nor in a dark room. The mother or some other congenial person should sit by the little one till it falls asleep, and a mild light be left burning until morning. The possible waste of gas is nothing compared with the real waste of nerve-power entailed upon a delicate child who wakes up in the dark alone. Finally, it is better that such a child, even when older, should always sleep in the same room with an adult and sympathetic person, to whom, without shame, he may creep to be soothed if he wakes in a fright. Such a provision is not to be neglected even for children of ten or twelve years, who are not unfrequently subject to attacks of night-terrors, but are, of course, much less noisily demonstrative about them than are infants in arms.

Night-walking—Somnambulism.

This is a nervous disorder of sleep, usually observed in persons who have shown symptoms of hysteria, and on this account is to be considered as a hysterical affection. It belongs to a large class of hysterical disorders, which includes catalepsy, ecstasy, susceptibility to magnetism, to hypnotism, etc. As with other manifestations of hysteria, it is much more common in the second half of childhood than in the first or period of infancy. It is much less frequent in children than in young women ; but as sex does not exclude from a capacity for somnambulism, neither, within certain limits, does age. On the one hand men, on the other children, endowed with a certain kind of nervous temperament, are liable to become sleep-walkers.

The peculiarity of somnambulism, which has been the subject of at least as much unreasoning superstition as of reasoning inquiry, consists in the ability to perform complicated actions that are related to the circumstances of a dream, and in no relation with the real surroundings of the body of the sleeper. Thus, the senses either convey no impressions from the objects causing them, or else impressions in accordance with the fixed circle of ideas which preoccupy the patient. The eyes may be shut, or widely open and staring. In the former case the patient is nevertheless quite able to find his way along perilous paths where he could not walk in the day-time, as the edges of roofs, the borders of precipices, narrow planks, across chasms, etc., and to perform very

complicated actions with great precision. In the latter case, there is the additional peculiarity that the patient seems to see some things correctly, while others make no impression upon him, or are grotesquely misunderstood. Thus, a somnambulist engaged in writing a letter, will procure real pen, ink, and paper, and will be unable to write if the paper be covered by another person, but may often continue to write when the light is almost extinguished. In such cases it would seem as if there were an exaltation of the power of sight to the extent of being able to discern objects with a light quite insufficient under ordinary circumstances, but not sufficient to look through opaque substances. In some cases of somnambulism, especially when the somnambulic condition has been brought on by magnetism or other artificial means, this latter power is, however, possessed, and the patient, blindfolded, describes concealed objects with the utmost accuracy. The description is obtained from a mental picture, and not from impressions made on the retina; since, when an opaque object is interposed between the object described and the eye, such impressions cannot be made on the retina. It is probable, therefore, that when a somnambulist writes or sews, etc., by an extremely dim light, that he is guided exclusively by the mental picture, and that he could act just as well in total darkness, for he does not see the person who interferes with his movements, nor does he recognize him as different from any inanimate object against which he may stumble.

In other words, the parts of the brain which usually receive impressions from the senses and become conscious of them, are so completely preoccupied by the circumstances of the dream, that all impressions fail to stimulate them to their accustomed activity, except such as are in accord with these circumstances. The mind seems to be held in a sort of rigid attitude, which may be entirely compared with rigidity of a limb in a cataleptic trance. During this latter state, any limb of a patient may be placed in any direction, however awkward and uncomfortable, and it will remain there, stiff as a piece of wax moulded to the shape. Similarly in somnambulism, a circle of ideas, feelings, and volitions is bent forcibly in one direction: neither floating idly, as in an ordinary dream: nor susceptible of modification from either former ideas or external impressions, as in wakefulness. The mind is cataleptic, and the closeness of the analogy between the two states is confirmed by their frequent occurrence in the same person, grafted on a common basis of hysteria.

The intensity of the preoccupation of the brain, or of some part of it by the dream, is not only indicated by this unsusceptibility to ideas or objects outside of the dream, but by the energy

with which the projects of the dream are put into execution. The somnambulist will take long walks, perform difficult feats of climbing, attempt to kill persons by whom he imagines himself injured, attempt to commit suicide. These various efforts are not suggested by any habitual train of ideas. The dream inspiring them may be as accidental in its origin as any dream; or it may be regularly recurrent for a succession of nights. But in the latter case, as in the former, all recollection of it is generally lost as soon as the patient awakes. This is not universally the case, however. In some celebrated examples of attempted homicide during somnambulism, the dream prompting the deed has been remembered and related the following morning. In other cases, however, and where the dream is continued from night to night, the patient gradually seems to acquire a double consciousness, and to lead two lives, each of which is quite different from the other, and quite oblivious of it.

The sleep-walking of children rarely presents the extraordinary phenomena which have been commemorated in the somnambulism of adults. The circle of ideas is so much narrower that the dreaming impulses are much simpler and nearer to every-day experience; only in the case of very imaginative children, whose brains have been excited by highly imaginative story-books, would there be reason to anticipate visions of extraordinary significance. But very commonplace dreams may lead to very serious results; as when a somnambulic child, intending to make his way to the store-room for cake, climbs out of a window.

When adventures of this kind are completely successful, however, it is important to be on guard against voluntary deception, which, even by children, may sometimes be very skilfully carried out. The complicated and concerted actions performed by the somnambulist do but extend the partial activity that is often manifested in disturbed sleep: the restlessness, tossing, turning, muttering, groaning, screaming, talking more or less consecutively. In all cases of such disturbance, the molecular movements on the surface of the hemispheres which coincide with the thoughts of the dream, excite molecular movements in those nervous ganglia at the base of the brain, in which originate the motor nerve-fibres destined for the muscles. In other words, the ideas in the dreams excite voluntary muscular movements in the same way that waking ideas would do. But, in a healthy state, the excitation of a dream is too feeble for this purpose. The somnambulic state differs: first, in that the dream, whose physical side is probably limited to a certain portion of the brain, dominates this so completely that it is withdrawn from the influence of

impressions registered elsewhere ; and second, in that the resistance to the diffusion of the excitation from the ideational to the motor part of the nervous system is unnaturally diminished. We have seen that such morbid concentration of sensibility on the one hand, and morbid diminution of resistance to impressions on the other, is characteristic of hysteria.

Somnambulism in children, therefore, is chiefly of importance as indicating a species of nervous temperament, which, later in life, will be very liable to become hysterical. This is far from being constantly the case, however. A fair proportion of childish somnambulism is observed among boys, while, as is well known, hysteria is very exceptional in men.

It is important for parents to be convinced that an attack of somnambulism does not threaten organic brain disease, which may, on the contrary, be indicated by symptoms much less apparently alarming. It is quite possible for an attack extending over several successive nights, or even weeks, to subside completely without recurrence. Sometimes, on the contrary, the habit may persist for years, yet the occasions of its exhibition may be rare.

When a child is discovered walking about in his sleep, it is very important not to awaken him suddenly. A suddenly awakened somnambulist is always frightened, and the shock, which to an adult might bring an attack of hysterical convulsions or of catalepsy, might induce in a child a prolonged illness of chorea (St. Vitus's dance)—so closely allied are all the nervous diseases, dependent, as they all are, on the instability of the ultimate molecular movements of the central nervous system.

The somnambulist, therefore, if discovered, should be gently led back to bed, and not informed until the next morning of his escapade. In any case, it will become the duty of the guardians of the child to watch him at night. A light sleeper should share his bed, ready to awaken at his movements ; and for greater security the windows and doors should be locked, and the key removed and secreted.

All the remarks already made, in speaking of night-terrors, about the removal of a predisposing cause—careful regulation of the digestion, and adoption of a mental discipline at once soothing and strengthening—applies here, and need not be repeated.

MARY PUTNAM-JACOBI, M.D.

Accidents and Emergencies.

BY

ALPHEUS B. CROSBY, A.M., M.D.,

OF NEW YORK CITY,

SURGEON TO BELLEVUE HOSPITAL; PROFESSOR OF ANATOMY AND CLINICAL SURGERY IN BELLEVUE HOSPITAL MEDICAL COLLEGE, NEW YORK CITY, AND PROFESSOR OF SURGERY IN DARTMOUTH MEDICAL COLLEGE
[*Since deceased.*];

ALBERT H. CROSBY, A.M., M.D.,

OF CONCORD, N. H.;

AND

JOHN T. HODGEN, M.D.,

OF ST. LOUIS, MO.,

PROFESSOR OF SURGICAL ANATOMY, FRACTURES AND DISLOCATIONS, AND CLINICAL SURGERY AT THE CITY HOSPITAL OF ST. LOUIS, MO.

ACCIDENTS AND EMERGENCIES.

An accident (*ad,* to, and *cado,* to fall) is an event that takes place suddenly without one's foresight. An emergency (*e* or *ex,* from, and *mergo,* to plunge) means, in this connection, an event or combination of circumstances calling for immediate action or remedy. All sudden exigencies require presence of mind and decision of character.

Nothing complicates an emergency like "old ladies of both sexes" who scream, get in every one's way, refuse to answer necessary questions, and *wind up* with an after-piece of hysterical ground and lofty tumbling. In all sudden catastrophes, the person having the most coolness and self-control should take command, and all bystanders should yield implicit obedience. All obstructionists should either keep quiet or be turned out.

In emergencies it is doubly true that "he that ruleth his own spirit is greater than he that taketh a city." Every one should impress on his own mind the fact that there is something for him to do, which, suppressing all emotion for the time being, he is to do calmly and persistently, that he may palliate human suffering until the doctor comes ; and that he may even be instrumental in saving human life—than which no consciousness can give greater pleasure.

With these brief introductory thoughts, let us consider the most common immediate effect of severe injuries, viz. :

Shock.

The immediate general effect, or shock, after injury manifests itself by a disturbance of the circulation of the blood, of the breathing, and of the nervous system. The harmony of action of the heart, the lungs, and the nervous system is deranged.

Symptoms.—After a severe injury, the sufferer becomes cold, faint, and trembling ; the pulse at the wrist is small and fluttering (may be wanting) ; the mind is depressed and disquieted, as shown by the expression of the face and confusion of thought and speech ; the skin may be covered by a cold sweat, and sickness at

the stomach, with vomiting and involuntary discharges from the bowels, may or may not occur. Shock is either mental or corporeal. Mental shock is due to the powerful impression made on the mind at the time of the injury. Timid, nervous persons may thus, after a trivial wound, present all the symptoms of severe shock due simply to the impression made on the mind. At the battle of the Fair Oaks, I saw a major in a Pennsylvania regiment struck by a bullet in the left breast. He fell from his horse with all the signs of a fatal wound, but an examination showed that the bullet had lodged in a memorandum-book in the breast-pocket, and that there was no wound of the officer's person. A drink of whiskey gave him "pot-house courage," and he speedily rallied from his mental shock. Nevertheless, mental shock may prove fatal; the actual fright may first depress the heart's action and eventually arrest it, the sufferer going into a swoon or faint from which he never rallies. It is seldom, however, that this result ensues, save in persons of a marked nervous habit. Corporeal shock represents the physical impression made by the injury, independent of moral influences.

A person during sleep, or under the influence of ether, may suffer severe injury, and, the mind being oblivious, there may still be shock; but it will be corporeal, representing the physical injury. The leg of a frog may be crushed by a hammer, and the heart's action will be immediately depressed, although no mental impression has been made. Severe corporeal shock may be due to an extensive injury of a part not essential to life, or to a slight injury of a part necessary to the maintenance of life. If severe shock manifests itself without any apparent injury, it is fair to conclude that there is some internal injury that causes it. All shock tends to death through depression of the heart's action; generally, however, the patient rallies, reaction comes on, and the disturbed balance is gradually restored. The reaction may be excessive; especially if stimulants have been used injudiciously, and the injured person may suffer from wound-fever for some days, which will then subside unless the primary injury was very grave. There are certain secondary or remote effects of shock that need not be dwelt on in a work of this character.

If the patient does not rally, he is liable to fall into a condition known as *collapse*. In this condition the face is pallid, the pupils of the eyes are dilated, the skin is cold and clammy, the breathing is feeble and gasping, the pulse is feeble or absent, and there is absolute muscular relaxation, together with a perturbed condition of the brain. The above-mentioned collapse is usually the precursor of death.

Treatment.—When the shock is mental, a moral remedy is

generally indicated. A few reassuring words, spoken in a kindly but confident manner, will usually be sufficient. A little wine or spirit, and water of ammonia applied to the nostrils, will usually be all the remedies required. If, however, the patient continues pallid, with a feeble pulse, he should remain in a horizontal position until these symptoms pass away. If the shock is corporeal and severe, the case will require more attention; the patient should be kept recumbent, and the injured part should be laid in an easy position on a pillow or otherwise. Warm blankets should be wrapt around him and bottles of hot water be placed at the feet, and, if necessary, about the body. Friction of the hands, feet, and general surface is advisable. Wine or whiskey or brandy, suitably diluted, may be administered every few minutes until the pulse begins to beat firmer and the surface grows warmer. Strong green tea, administered hot, is an excellent stimulant. If the patient vomits or is too far insensible to swallow, ammonia may be applied to the nostrils, and two to four tablespoonfuls of whiskey, diluted with an equal quantity of milk, may be injected into the bowel. It may be necessary to press the lower end of the bowel with a napkin for a few minutes, to insure its retention. If there is much pain or extreme depression, stimulating doses of laudanum may be given (five drops every fifteen minutes until five or six doses have been given). Let it be understood that stimulants are not to be used indefinitely. As soon as the pulse and temperature begin to improve, *i. e.*, as soon as reaction begins, nature will usually accomplish the rest, without any or at least with only moderate stimulation. Excessive reaction leads to fever, and therefore an intelligent physician should determine the subsequent steps in the treatment.

Fainting.

Fainting, swooning, or *syncope,* as it is technically called, is due to sudden and overwhelming depression of the heart's action. In fact, at the instant of fainting, the heart actually ceases to contract, and thus, the blood failing to be sent to the brain, consciousness is lost, and the nerves of respiration which come off just below the brain, not getting their usual stimulus (the blood), breathing becomes disturbed, or is suspended. This condition of things lasts but a few seconds, otherwise death would ensue. Fainting may occur because the natural stimulus of the heart—pure blood—fails to reach it; as when a large vessel is wounded and the injured person bleeds to death. Anything that arrests the contraction of the heart will induce fainting. Certain poisons spend

their force in this way on the heart. Excess of emotion, as of grief, terror, or even excessive joy; lightning strokes, concussion and blows on the pit of the stomach, are all liable to cause fainting, and from this condition the sufferer may never rally. Persons suffering from starvation or long-continued wasting diseases, are very liable to faint. The sight of blood, or the association of painful ideas, may also cause fainting.

Symptoms.—When a person faints, the face suddenly becomes blanched, the pupils dilate, the breathing assumes a gasping character, the pulse is feeble, or temporarily arrested, vertigo and loss of consciousness ensue, and unless supported the sufferer falls, the whole body being limp and relaxed. There is but a line between this condition and death, and yet persons in reasonable health almost always recover from a swoon.

Treatment.—When a person faints he should be immediately laid on his back, with the head a little lower than the heart, by which the flow of blood towards the brain and its necessary stimulation, will be favored. The dress about the neck, chest, and waist should be completely loosened. Dashing cold water from the hand suddenly into the face will usually excite a gasp, and may be repeated if necessary. Applying ammonia to the nostrils (not too strong), pushing the forefinger backward into the throat and gently stimulating the opening into the wind-pipe, or smartly slapping the left side of the chest over the heart, may all be tried if necessary. The patient should have an abundance of fresh air, and if the faint is persistent, four tablespoonfuls of whiskey or brandy mixed with a like amount of warm water, or milk, may be thrown into the bowel with a syringe.

The patient should be kept flat on the back until the pulse and color are restored, and a moderate stimulant will aid in the restoration.

If the stomach and bowels are believed to be overloaded, a dose of castor oil (one to two tablespoonfuls) or Epsom salts (one tablespoonful), will relieve the patient and be likely to prevent a recurrence of the fainting.

Finally, let it be remembered that to hold a fainting person bolt upright is fraught with danger.

Bleeding.

Bleeding, or hemorrhage, as it is called by surgeons, consists in the escape of blood from the blood-vessels that have been wounded. A little blood makes a great show and excites much alarm that is usually quite unnecessary. A reasonable amount of coolness

will enable any person to determine the character of the bleeding, and how to control it, at least till the surgeon can be procured. Many valuable lives have been lost through lack of a very little knowledge and limited self-control. If a layman will pour cold water freely over a wound, he may observe that the blood, bright red in color, flows from one or more points in jets or in an interrupted stream corresponding to the pulse at the wrist. This bleeding comes from arteries—tubes that carry blood *from* the heart. If the observer will carry his thumb or finger directly down on the bleeding point and make gentle but persistent pressure, he will control all the dangerous part of the bleeding until surgical help can be obtained. If the blood is deep blue or blackish and the flow is constant from one or more points, it comes from veins—vessels that carry blood *back* to the heart. To elevate the part and press the edges of the wound firmly together, will control bleeding from the veins. If the wound is wiped, blood will be seen to ooze from innumerable and minute points over the whole surface, and this is from wounded capillary vessels—minute hair-like tubes that connect the very small arteries and veins. A stream of cold water poured over the wound, or persistent pressure of the surfaces of the wound firmly against each other will control this form of bleeding. But in addition to these general points let us consider the more important forms of bleeding likely to occur and the immediate treatment to be adopted in each.

Bleeding from the Nose

is generally unattended with danger; sometimes it acts like a safety-valve and averts more serious danger. In order to arrest it, let the patient sit erect, holding the hands clasped above the head until the bleeding stops. This almost always suffices, but if the bleeding is persistent, the back of the neck and face may be bathed with ice-water. A solution of alum in cold water (as much as the water will dissolve), may be squirted up the nostrils with a syringe. A very simple and efficient mode of checking nose-bleed is the inhalation of the vapor of turpentine. The mode of using this valuable remedy is described at length in the section which treats of bleeding from the lungs and stomach. In extreme cases the nostril may require plugging, but in such an event a physician should be called in, as the operation is one requiring knowledge and skill. Should, however, the bleeding resist the simple methods described, and should the patient be unable to procure the immediate attendance of a physician, it is always safe to plug the nostril a short distance, provided the plug or cone is made so large that it

cannot be pushed too far into the nostril. The plug may be made of old cotton or linen rolled into the shape of a cone and wound firmly with thread, being careful to have the surface smooth. This can be dipped in strong alum water, or, better still, in spirits of turpentine, and pushed into the bleeding nostril as far as the base of the cone will allow. If it checks the bleeding it may remain twenty-four hours, and, if necessary, a new one may then be made and inserted.

Bleeding from Wounds of the Limbs.

Bleeding may be controlled when a *leg or an arm* is wounded by pressure over the main artery of the limb in the following way. Place a stone (the size of a pullet's egg) or a potato in the middle of a handkerchief, roll it in, and make a single slip-knot with the ends to hold the pad in place. The pad thus formed in the middle of the handkerchief should then be placed over the main artery of

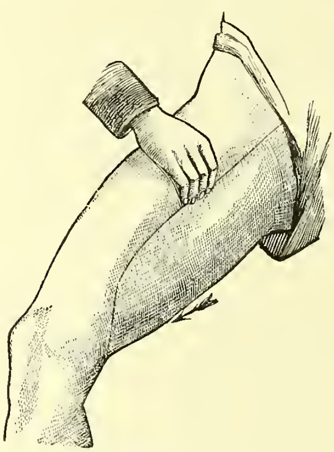


Fig. 227.

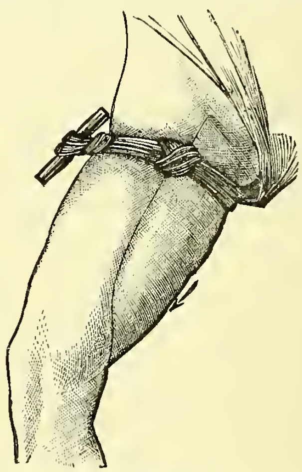


Fig. 228.

Figure 227.—Showing the course of the large artery on the inner side of the right thigh, and the position in which to place the fingers so as to compress it. The arrow shows the direction of the blood.

Figure 228.—Showing the position of the knotted handkerchief and the pad, with which to compress the artery of the thigh (right side).

the limb, and the ends of the handkerchief should be carried around the limb and tied until the bleeding stops. In the case of a leg, the point of pressure may be made out as follows. Place the finger over the centre of the groin, then carry it downward and a little inward for two and a half to three inches, and there apply the pad. This will bring the pad over the large artery of the thigh, and will control very severe bleeding. In case the handkerchief and pad

should not be sufficient to restrain the flow of blood, a stick may be passed between the handkerchief and the limb, and then by a twisting motion the pad may be pressed upon the artery with sufficient force to stop any hemorrhage, no matter how severe (see figures on preceding page).

In case the arm is injured above the elbow, the large artery may be found upon the inside of the limb, in a line with the angle formed by the shoulder and the body when the arm is hanging in a natural position (see below). Should the injury be below the knee or elbow, it is often possible to control the bleeding by sharply flexing or bending the limbs at these joints, and holding them in that position by tying a strong bandage or handkerchief around

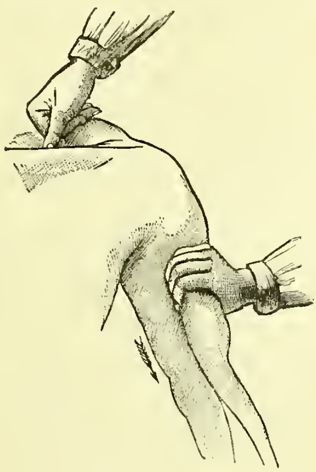


Fig. 229.

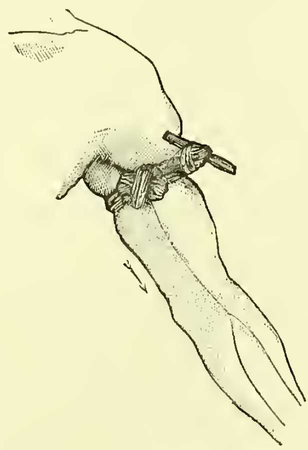


Fig. 230.

Figure 229.—Showing the course of the large artery in the left arm, the course of the blood, and the point at which pressure must be made with the fingers to arrest its flow.

The upper hand is represented as compressing the artery where it passes behind the collar-bone—this plan being resorted to when the injury causing the bleeding is near to the body.

Figure 230.—Showing the manner of employing the knotted handkerchief, to arrest bleeding from a wound of an artery in the left upper extremity.

the leg and thigh or the arm and shoulder, and bringing them as nearly together as possible. The philosophy of this method is obvious when one remembers that the large blood-vessels pass through the large joints to supply the limbs below, and by strongly bending the part below the joint upon the part above, the arteries are compressed and a large portion of the blood shut off.

Bleeding from the Mouth and Bowel.

Accidental or spontaneous *bleeding from the stomach, bowels, lungs,* and *from the nose* even, come almost exclusively within the

domain of medical practice, and are seldom treated with domestic remedies; but while waiting for the physician, some time and much blood may be saved by the judicious use of certain means usually available in every family. Bleeding from the *stomach* seldom occurs except as the sequence of some severe and long-standing disease for which a physician is already in attendance, but it occasionally happens that a person without previous warning will vomit quite a quantity of blood. It may be known readily that it comes from the stomach, and not from the lungs or upper air-passages, *first*, by its being sometimes mixed with particles of food; *second*, by its color, which is invariably darker than blood from the lungs—being changed by contact with the fluids of the stomach from red to a color which varies from a light brown to a dark shade resembling coffee-grounds. It is this change in the color of blood ejected from the stomach that gives the name of "black vomit" to a disease well known in the tropics; *third*, by its being thrown from the throat and mouth by retching and vomiting rather than by coughing. Nausea is also common where blood comes from the stomach.

It sometimes happens that bleeding from the *nose* occurs so far back in the nostrils that the blood falls into the throat and is swallowed; this blood is changed in color in the same manner, and if vomited is dark and grumous. Blood from the lungs or air-passages is bright red in color, and if small in quantity is usually mixed with mucus and air-bubbles. When it happens as an accident in a case of consumption, it is frequently mixed with pus, or "matter," as it is called. It is coughed up rather than vomited, and it very seldom occurs to a person with sound lungs.

Bleeding from the *bowels* need not be dwelt upon, as it is usually caused by hemorrhoids or "piles," or is a complication of some disease like typhoid or continued fever, and in either case a physician should be summoned. Fortunately, almost every family has a remedy at hand which is very useful in the class of cases just considered, and the exhibition of which is perfectly safe, in moderate quantities, while awaiting the coming of the doctor. I allude to spirits of turpentine, one of the very best arresters of hemorrhage or bleeding known to medical science. In case of bleeding from the lungs, a cloth should be saturated with the pure spirits of turpentine and the patient should hold it as near as possible to the mouth and nose and inhale the vapor as rapidly as possible, taking deep inspirations and renewing the turpentine as fast as it evaporates. Another and very efficient mode of converting it into vapor is to partly fill a tea- or coffee-pot with boiling water, and then pour a tablespoonful of turpentine into it. Then the face and the vessel

containing the remedy may be enveloped in a napkin folded to reresemble a funnel, and the inhalation continued until the water grows cool. Then more boiling water and turpentine may be prepared, if necessary. At the same time, it is well to give alternate teaspoonfuls of vinegar and paregoric once in fifteen minutes until two doses of each have been administered. The chest may be sponged with vinegar and water, and the shoulders should be held up by bystanders or supported by pillows. Do not permit the patient to talk or make any bodily exertion. Salt is a popular domestic remedy in all cases of bleeding from the mouth, whether from the lungs or stomach, and in the absence of anything better it may be given mixed with pounded ice. In cases of bleeding from the stomach, ten drops of turpentine may be taken in a little syrup or sugar and water—from a teaspoon, and the dose repeated in fifteen or twenty minutes until thirty drops have been taken. Its further administration should be left to the discretion of the attending physician. If this does not materially check the bleeding, or if the turpentine is not at hand, give a teaspoonful of vinegar or a little Epsom salts dissolved in water; whatever else is administered, pounded ice should be given freely and swallowed rapidly, so that it may reach the stomach before it is dissolved.

Bleeding from Wounds of the Head and Trunk.

Bleeding from wounds of the head or trunk must be controlled by direct pressure with the fingers until surgical aid can be obtained.

Cuts about the head and face bleed freely because the capillary vessels are large in these regions. The appearance of a child with such a cut, the blood streaming down over the face, is not reassuring to an anxious mother, and yet there is rarely any danger to life from this kind of bleeding. If the blood is washed off, it will usually be found that the cut is small, and a little persistent pressure with a cold wet rag will be sufficient to arrest the bleeding. If it is difficult to stop this, whiting, pipe clay, wheat flour, or earth even, applied over the wound, a piece of lint over this, and firm pressure with the finger over all for a few minutes will probably suffice. The lint may then be carefully removed, allowing all the whiting to remain that will stick, and a piece of common adhesive plaster may be applied over the wound. A *leech-bite,* if troublesome, can be controlled in a similar manner.

It is often possible to check small but persistent hemorrhages by the use of astringents, which act by causing a clot to form

which plugs the bleeding vessels. Of these the most available are powdered alum and scrapings of sole-leather (which contain tannin, one of the best astringents), and (in the country) that peculiar dried fungus called the "puff-ball," which is so common in grass-land and pastures. A common domestic application is a ball of cobwebs compressed by the fingers into a firm mass. Any one of the above may be applied directly to the bleeding surface, and if a clot does not form at once the wound may be partially cleansed by removing the astringent with the finger (no water must be used), and a fresh application be made. If a few applications do not check the bleeding, pressure may be added. Should the bleeding yield to the application, the wounded part must be kept perfectly still to encourage the formation of a firm clot. Position has a great influence in arresting bleeding; *e. g.*, the hemorrhage from a wound in the hand may be perceptibly checked by elevating the member above the head and holding it there until other means are prepared. For a wound in the foot place the patient upon his back and elevate the leg, resting it upon the back of a chair. Before leaving this topic, it seems proper to notice certain peculiarities in the distribution of the blood to the hands and feet, which might cause needless alarm in case of injury, unless explained. The arteries which carry the blood down the arms and legs—one large vessel on each side—*unite* in the palm of the hand, at the roots of the fingers, to form an arch called the "palmar arch," and at the roots of the toes to form the "plantar arch." Now, as people receive wounds that extend entirely across the palm of the hand or sole of the foot, as by falling upon glass or some sharp tool like an axe or a scythe, while the hands are involuntarily extended in the effort to avoid injury,—or, in the foot, by stepping or jumping upon some similar object, it is obvious that these arches may be cut entirely across, thus dividing the large arteries, both of which require pressure to check the hemorrhage; or one side of the arch only may be cut, and still there will be two sources from which blood will be sent forth in jets. Mild measures will not answer here. The limb must be held by a person on each side, making strong pressure upon the *two* arteries with the fingers, or, what is

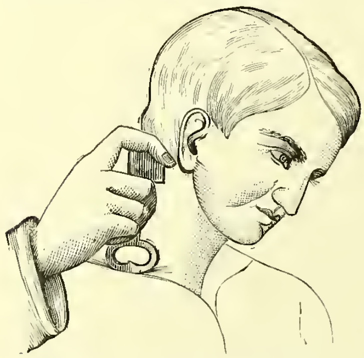


FIGURE 231:—Showing how to use a large key (or similar object), to make pressure on the artery lying behind the collar-bone. The handle of the key should, however, first be wrapped with a piece of cloth, like a handkerchief, to prevent bruising the skin.

better still, apply the handkerchief and pad above the elbow or knee, as the case may be, and, to "make assurance doubly sure,"

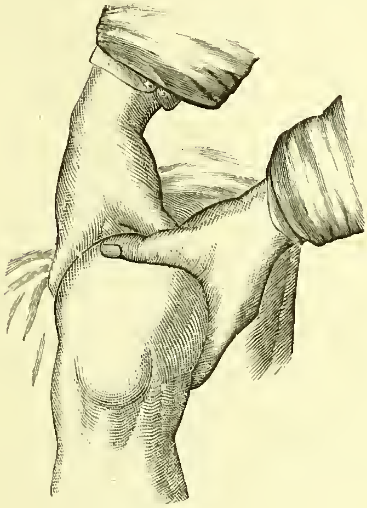


FIG. 232.

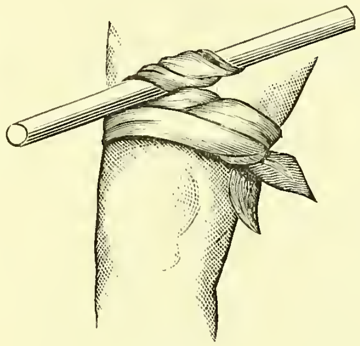


FIG. 233.

FIGURE 232.—Showing the manner of compressing the large artery of the lower limb, where it passes down in the centre of the hollow behind the knee. A pad or hard body of convenient size being placed in the hollow space, pressure is kept up with the fingers applied over it.

FIGURE 233.—Arrangement of the handkerchief-tourniquet to arrest bleeding from a wound below the knee. A large pad made by folding a towel, or napkin, or rolling up a woollen stocking, must first be put into the hollow behind the knee, and the handkerchief applied over it.

bend the limb strongly and hold it in place by a bandage or rope, or with the hands even, "until the doctor comes." (See chapter on Anatomy for the course of these arteries.)

Note!—Never depend upon home treatment for a deep wound either of the palm of the hand or sole of the foot, for it sometimes puzzles the best physician to find and tie the two ends of the bleeding vessels, and he is often compelled to cut down upon the arteries in the arm or leg and tie them there.

WOUNDS.

Having discussed the subject of bleeding and its treatment, which is one of the first results of certain wounds, we will proceed to treat of the injuries themselves. In all elementary works upon practical surgery, wounds are divided into several classes, viz.: the incised, or clean cut, usually made with cutting-tools or glass; the lacerated, or torn; the contused, or bruised, and the punctured or penetrating, which are those made made by instruments whose length greatly exceeds their breadth, and including stabs and pricks of all sorts. To these we may add poisoned wounds, bites, stings,

and scratches. Incised wounds are usually produced with little violence and generally admit of repair most easily. These wounds differ in degree from the cut finger of the school-boy to the fearful incisions caused by falling upon a scythe, or the still more dreadful wounds inflicted by a razor in the hands of a negro—that race being accustomed to use that weapon exclusively in their hand-to-hand conflicts.

The writer once attended a soldier who, while on patrol duty, had attempted to arrest a colored recruit who was drunk and disorderly. The negro attacked him with a razor, and the soldier came to my quarters holding up his abdomen in both hands. Examination showed that he had received a cut completely across the abdomen, more than thirteen inches in length and through which the intestines were protruding, although fortunately they were not wounded; and such is the reparative power of nature, that this man recovered and returned to his regiment.

Treatment.—Slight cuts need no treatment further than to wash them by pouring a stream of water upon the cut, to remove any foreign substance like sand or dirt, and to check the bleeding, and then the wound may be "done up" in a narrow rag, if upon a limb, and left to heal. It is well always to press or pinch the edges of a wound together for a minute after it is washed and dried, in order that it may heal immediately, or, as surgeons say, by "first intention." Nearly all clean-cut wounds, if properly and promptly treated, unite in this way—that is by dry union without the formation of pus, or "matter," as it is commonly called. Where clean cuts are attended to at once and the sides pressed into exact apposition and retained there by plaster and bandage, it sometimes happens that no scar is left. Hence the greatest care should be exercised in dressing wounds about the face and neck.

Persons called upon suddenly to dress a wound of any kind, should bear in mind that there are four things to be accomplished, viz.: 1st. To check bleeding. 2d. To remove from the wound any substances like dirt, glass, splinters, bits of cloth, etc. 3d. To bring the parts that have been divided into their natural position and to keep them well together. 4th. To promote repair or union of the severed parts by perfect rest. The various modes of checking bleeding have already been fully discussed, but the reason why blood should be removed from the sides and edges of an incised wound are, that it interferes with the process of repair if present in any considerable quantity, as it forbids healing by immediate union, and may prevent union by "first intention." If a large quantity is left between the sides of an incised wound it will probably break up and act as a foreign body, causing irritation

and inflammation. The wound should be thoroughly cleansed, as the presence of foreign bodies will entirely prevent union. The divided parts should be brought into a natural position and *kept* so, because if the edges of an incised wound are allowed to gape, repair cannot take place directly or by dry union. Lastly, if injured parts are not kept quiet, repair cannot go on in any form. In dressing an incised wound, then, after the bleeding has been completely checked, the parts should be washed by means of a stream of cool or luke-warm water, poured from a pitcher or some other convenient vessel, or squeezed from a sponge, and all foreign substances floated out. If bits of cloth or splinters are present and cannot be removed in this manner, they must be taken out with the fingers or a pair of common tweezers. Even a hair-pin may be made to do efficient service in this way. The parts should then be thoroughly dried by pressing them gently with a soft cloth, and then we are ready to fulfil the third indication, viz., to bring the parts into their natural position and to retain them by plaster and bandages. The question here arises, What is the best adhesive plaster for common family use? Almost every family has on hand a small supply of some kind of adhesive plaster, usually the common old-fashioned "court-plaster," which consists of fish-glue, isinglass or mucilage spread upon silk and dried. When wanted for use this is moistened with the tongue or a damp sponge and applied. Latterly, a great variety of so-called "moisture plasters" have been put into the drug stores by different manufacturers, and the adhesive material is spread upon all sorts of fabrics, such as silk, cotton-drilling, muslin, linen, and cotton-flannel. It is also put up in a variety of forms. Perhaps the best plaster of this kind is manufactured by "Mitchell," of Lowell, Mass., and put up in strips one yard long and of various widths, from one-third of an inch to one and one-half inches, rolled upon a block like ribbon. For a slight incised wound no plaster could be better, as it adheres very firmly and is always ready for use. As will be presently seen, however, it is often necessary to apply moisture to the wound and adjacent parts, and here we must have a plaster which is prepared for application by heat, and which cannot be loosened by moisture after it is applied. For this purpose we have the machine-spread adhesive plaster, which is composed of pitch or resin with litharge, and spread upon cotton cloth. Within a few months Metcalf & Co. of Boston have given us an improved plaster of this kind, invented by Dr. H. A. Martin of that city, containing a certain amount of India-rubber and balsam tolu, which not only renders it soft and elastic, but enables us to apply wet cloths over the wounds without disturbing the plasters. As a matter of precau-

tion, every family should have a roll of Mitchell's "Novelty" or Martin's "Surgeons' Adhesive Plaster" in the house for emergencies, and as they fulfil different indications, it is a good plan to have both kinds on hand.

Having decided upon the plaster, we are now ready to apply it. The plaster should be cut in strips from one-fourth to one-half an

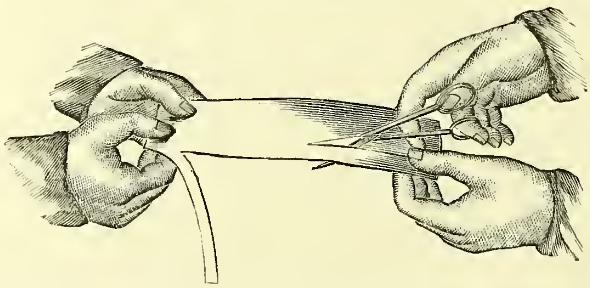


FIGURE 234.—The cutting of adhesive plaster strips will be greatly aided if a second person holds the farther end, and keeps the whole piece drawn tightly, as above shown.

inch in width according to the length of the cut, and long enough to get a firm hold upon the skin. The wound should be held so that the edges approximate exactly, and the plaster should usually be applied at right angles to the incision. Frequently one strip is sufficient to hold the parts together, and the centre of the strip should cover the incision. It is well to apply one end of the strip first and press it closely upon the skin for a few seconds, then, pushing the edges of the wound well together, the other end of the strip should be pressed upon the skin and the parts held until the plaster has secured a good hold. If the cut is an inch or more in length, several strips should be prepared and applied one after another, as shown in the adjoining figure, until the wound is securely held in place. The lower or most dependent end of the wound should not be covered with plaster, for, if blood or matter accumulates in the cut, it should have a point of escape or drainage, or it will "burrow" and separate parts already united. In fact, there should be a narrow space between all the strips of plaster, instead of cover-

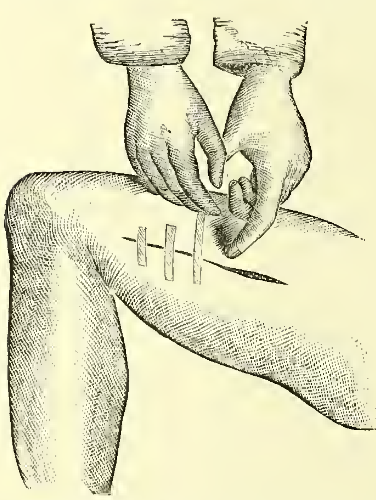


FIGURE 235.—Method of applying strips of adhesive plaster to a cut or long lacerated wound.

ing it completely, as is sometimes done. If the wound is little more than skin-deep, no further dressing is needed save to have it covered with mutton tallow or simple cerate, which is placed over the plaster that the bandage may not adhere, and then the wound should be covered with a bandage secured by a pin or a stitch. If the wound extends through the skin and fat into the red flesh or muscle, the strips of plaster should be as long as the locality of the cut will allow, and applied as directed. Then two rolls of linen or lint, as long as the cut and perhaps one-fourth of an inch in thickness, should be wrung out in cold water and laid over the plasters, one at each side of the cut, and over this put a bandage drawn moderately tight. These "compresses," as they are called, are to support the deep-seated part of the wound. If the wound feels perfectly comfortable the bandage need not be removed for a day or two; but if there is heat and pain, the bandage and rolls may be removed and fresh ones replaced, soaked in water with a little laudanum added to it. In four or five days the whole dressing should be removed and fresh plasters applied, bearing in mind the importance of *putting on each new strip of plaster before the next old one has been removed.* It is also very essential that the plasters should be removed by loosening both ends of each strip and pulling them gently towards the cut, so that the partially-united edges may not be torn apart.

If the wound has begun to seal up by dry union, no further dressing except the plaster and the bandage will be necessary; but if the wound is open and pus or matter appears at the surface, then the plasters should be applied to keep the edges as nearly together as possible, and lint or linen rags wet with cold water should be applied and a bandage over all; and these last dressings should be kept constantly wet until the wound is healed or nearly so. Twice daily, at least, a gentle stream of water from a vessel or a sponge should be allowed to flow over the wound to remove the superabundance of pus; but the sponge should not be pressed against the wound, as that would wash off the very fluid that is necessary for the repair of the wound. As it must frequently happen that severe incised wounds occur where it is impossible to secure the services of a surgeon, and where no kind of plaster is at hand, it seems proper to give some general directions for bringing the edges of the wound together with stitches, or "sutures" as they are called. This is a very simple operation, as it can be performed with any kind of needle and any kind of white thread. If procurable, the three-sided "glover's" needle is the best for the purpose, as it passes more readily through the skin, but any common sewing-needle—say No. 7 or No. 8—will answer the purpose.

Silk or linen is better than cotton thread. White shoe-thread or bookbinder's-thread is often used as a matter of preference by physicians.

The bleeding having been checked and the wound cleansed, the edges should be brought together and the needle, with a well-waxed thread, should be passed through directly from side to side, inserting the point of the needle a little way from the cut and bringing it out the same distance from the wound upon the opposite side. It is sometimes easier to pass the needle through one lip of the cut and bringing it out with a few inches of thread, and then pass it through the other lip from the inside. The thread should be left of good length, and the needle-end cut off so that all the stitches needed may be put in before any of them are tied. If the wound has a tendency to gape, the sides should be held together by an assistant while the operator, commencing at one end, ties each stitch by itself, drawing them just tight enough to bring the edges into a natural position. The knots should be so tied as to prevent yielding or slipping. The wound may then be covered with a double strip of linen rag wrung out in cold water, and a tight bandage over all. The stitches can be easily removed at the end of four or five days by cutting the loop of thread *just below* the knot and then pulling upon the knot with the fingers or tweezers. Wounds of the scalp are generally treated in this way, as it is very difficult to shave the head so perfectly that plaster will adhere for any length of time. It is recommended to tie locks of hair together over the wound, thus bringing the edges together, but this is often difficult if not impossible. In the few cases where the writer has succeeded by this method the hair was quite long, and three or four strands were secured upon each side by waxing together a few separate hairs into one thread, while all the hair not needed for the purpose near the edges of the wound was cut away. The greatest possible care should be taken in cleaning a scalp-wound to free it from *all sorts* of foreign substances, including the clipping of the hair, which is very apt to adhere to the fresh surface. Wounds about the head, however, should always be treated by a surgeon when possible, as they are often followed by dangerous inflammation.

Punctured Wounds.

Punctured wounds are perhaps the most common of all accidental breakages of the skin. They are made with all sorts of instruments, from the finest needle to a bayonet, and one case has come within the knowledge of the writer where a man fell from a barn-scaffold upon a cart standing on the floor beneath. He was

literally impaled upon one of the sharp-pointed stakes that surrounded the cart, the stake entering his body just below and back of the right hip-joint, and, passing diagonally across the trunk, came out under the left nipple, exposing six inches of the point of the weapon. The stake was with great difficulty pulled from its new position by a bystander before the arrival of a doctor, and, strange to say, the patient recovered. Still more wonderful was the case of a man who, in the year 1848, while blasting rocks in Ludlow, Vermont, had an iron drill three and one-half feet long and one and one-quarter inches in circumference driven through his skull and brain, the drill entering just under the cheek bone, and, passing upward and backward, made its exit in the very centre of the skull. This man was living and in fair health ten years after the injury, and was seen by the writer personally. Upon the other hand, a punctured wound of the foot caused by stepping upon a rusty nail has not unfrequently resulted in the death of the patient. Thus we see that a punctured wound is not dangerous in proportion to its extent, for the danger lies more in the character of the wound and the weapon which inflicted it than its mere size. When a punctured wound is made with a sharp, clean instrument, such as a needle or a thorn, and if the wound does not affect any important organ or any diseased tissue, it generally heals at once by nature's own process, and without assistance. This is especially the case if the wound is small, as large wounds of this kind scarcely ever heal by primary or dry union, but fill up from the bottom by the formation of new flesh—a process which will be described hereafter. When the flesh is penetrated by blunt, rough, or dirty instruments, such as the rusty nail or the prong of a hay- or manure-fork, the wound never heals kindly, for the flesh is torn and bruised as well as separated by the perforating instrument, and closes together as soon as the weapon is withdrawn; thus blood, iron-rust, sand, and dirt are retained, and in a few days pus and broken-down particles of skin and muscle are added to the above, and should the foreign matters decompose or irritate by their presence, severe inflammation ensues, with great danger to the limb if not to life. Again, at the bottom of one of these punctures made with a dull instrument a nerve is not unfrequently *bruised*, but not cut off entirely, and this adds another danger in the shape of lockjaw, a disease which is often caused by wounds of this character. Where the parts are dense and consolidated with a large amount of tendon, as in the sole of the foot and palm of the hand, these wounds are full of danger and should not be neglected a moment. It should be remembered that, even in clean wounds of this kind, pus may form in the bottom of the puncture

while the upper part is nearly or wholly closed, and that this pus has a tendency to burrow among the deep-seated muscles, causing great pain and some danger to the limb.

Treatment.—Knowing, thus, the dangers to be apprehended, the treatment readily suggests itself. The first thing to be done is to remove the offending instrument if still in the wound. If this be a *thorn* or a *splinter* of wood or bone, the point of entrance should be enlarged a little, if necessary, with the point of a sharp knife, and the object seized with tweezers or forceps and withdrawn. Do not pick at it with a pin or needle, for you only break the end of the splinter and irritate the wound without doing any possible good. If the object to be extracted is a *needle*, keep the part perfectly still until you get ready to remove it, for the slightest motion will sometimes cause it to disappear among the muscles, where it cannot be reached. This, however, is of no consequence, for a needle in this situation rarely does any harm, and it will probably some day make its appearance again near the surface, and can then be removed. If possible, hold the part containing the needle in such a manner as to push one end against the skin, when a slight cut can be made directly over it and the needle pushed through, where it can then be seized and withdrawn. A *fish-hook* is often thrust so far into the flesh that the barb prevents its withdrawal. Under these circumstances it is useless to pull upon it, even if the opening has been enlarged. The easiest mode of extraction is to push the point of the hook upward through the skin in another place until the barb is exposed, when the barb and point can be cut off with a pair of cutting-pliers or a small file, and the hook drawn back through the opening made at its entrance into the skin; or, if no pliers or file are to be had, cut away the line and draw the shaft of the hook through the opening made by the exit of the point.

When punctured wounds are larger or made with a rusty or dirty instrument, the wound should be thoroughly cleansed with warm water in a stream or squeezed from a sponge; a compress of lint or old linen should be applied over and around the wound and kept in place by a bandage drawn moderately tight, the object being to exert sufficient pressure to force the sides of the puncture together at the bottom and induce healing by dry union and prevent the burrowing of pus. The parts should be kept elevated and perfect rest enjoined. When all goes on well, and repair progresses favorably, this dressing may be kept on four or five days and then removed, but the wounded part should rest for another week at least. Should pain or swelling ensue after this dressing has been applied, and should it increase in severity after its first appearance, the dressing should be removed and warm

water applications, or a large poultice applied and changed very frequently. Should no relief follow, and especially should the pain assume a throbbing, cutting character, while the redness and swelling about the wound increases, we may assume that pus is retained in the bottom of the wound and that prompt and heroic measures are necessary. The wound should be opened and enlarged with a sharp-pointed pen-knife, the extent of the cut depending upon the tension and swelling of the parts around the wound. The blade of the knife should be carried to the bottom of the wound, for if free exit is not given to the retained matter, the operation is useless. Such an incision may also sever a thread of nerve-fibre which has been bruised, and thus afford the patient instant relief from the most excruciating pain, to say nothing of the assurance which it gives against lockjaw. No intelligent person need hesitate to make such an incision in the absence of a physician, for any remote danger arising from the cut is infinitely less than the immediate dangers to be apprehended from inflammation, abscess, or lockjaw. The cut once made should be kept open until the discharge of matter ceases, when it may be allowed to heal. It must not be supposed that the relief following the incision will always be immediate and complete, for it often happens that the parts around the wound remain swollen and somewhat painful for some little time. In such cases the parts should be covered with a thick poultice, frequently changed, while a double fold of cotton rag saturated in warm laudanum and water, mixed in equal proportions, may be laid upon the parts and the poultice applied over that. To sum up the treatment of punctured wounds bear in mind that the compress and bandage, the poultice and the incision, are sufficient to meet the indications in a large majority of cases, while the time-honored slice of salt pork and the equally nasty poultice of soap and sugar should be discarded as filthy relics of ignorant barbarism. It should be borne in mind that wounds of this character, if severe, are apt to be followed by great constitutional disturbance of the entire system with more or less prostration, and to meet this, the patient should be well fed upon milk, nutritious broths, eggs, etc., and if necessary, stimulants should be sparingly administered.

Lacerated and Contused Wounds.

In the section upon incised wounds, mention was made of the repair of such wounds by *primary or dry union*, and before we pass to the consideration of contused or lacerated wounds, it is important that we should understand how *they* heal, so that the

rationale of treatment may be apparent to the reader. Where a wound gapes from any cause so that the edges cannot be brought together, it is said to heal by *granulation* or secondary union. If we examine an open wound when it is a few hours old, we shall find it covered with a jelly-like film of a grayish-white color. As time passes on, the film takes on a red color and the surface of the wound becomes more even, while the film itself becomes tougher and the wound pours out a yellowish fluid and begins to "clean" and to become perfectly smooth. In a day or two this surface again becomes uneven from the growth of large numbers of little elevations, from the size of a millet-seed to a hemp-seed. These elevations, which vary in color from a pale to a deep red, are called granulations, and they pour out a fluid of a creamy yellow color, which is called "laudable," or healthy pus. This is the dressing which nature furnishes to protect these delicate grains or granules of flesh with which the wound is rapidly filling. These granules are filled to overflowing with blood, and covered with a membrane so thin that the slightest touch causes the blood to flow. The granules continue to increase in number until the wound is filled up to the edges of the sound skin. Sometimes the granules are so luxuriant in their growth that they rise above the level of the surrounding skin ; and then we have that universally dreaded, but perfectly harmless condition of things, known as *proud flesh,* a healthy process of nature, which is less understood and is the cause of more needless alarm than any phenomenon within the domain of surgery. Please note that *proud flesh* is a bugbear which should never disturb the equanimity of an intelligent man, when occurring during the healing of a wound upon the body of a healthy person, and that no treatment is necessary beyond the application of an adhesive plaster or some astringent powder, like burned alum, or tannin. If we examine the margin of a wound when these granulations have reached the level of the skin, a dry red band will be seen, which becomes purplish-white where it comes in contact with the sound skin. This band is the beginning of the new skin which is to cover the wound and which grows from the outer edge toward the centre. The new skin is now called the "cicatrix," or scar, and is red at first, but gradually it grows paler as it contracts and becomes steadily smaller, until, in process of time, it nearly disappears, except in certain cases to be mentioned under the head of "Burns." It is an interesting fact that a scar or cicatrix eventually becomes like the tissue in which it is situated. Thus a scar in the skin becomes in time like true skin, a cicatrix in bone like true bone, and a cicatrix in a tendon becomes dense and compact like true tendon, The repairing

material becoming in every instance like the tissue with which it is connected.

Scabbing.—This is the third method by which wounds heal, and should be briefly alluded to, as some lacerated and contused wounds heal in this manner. When wounds heal by scabbing, the granulations heretofore described do not form, but the parts protected by a natural or even an artificial scab heal rapidly by a process similar to primary or dry union, and a scar is formed at once. The blood which is poured out upon the surface of a superficial wound is rich in scab-making material, and thus forms a protective film over the wound, under which the healing process goes on rapidly. An artificial scab may be made by wetting a bit of lint or linen-scrapings in a little fresh blood and then placing this upon the wound and securing it there with a strip of silk court-plaster, or even a rag bandage. The well-known value of felt or cotton-wool as a dressing for fresh wounds depends upon this property of the blood. All surgeons admit that this is the best and least painful form of healing, but unfortunately it is rarely seen, for to insure success, the dressing should be applied or the blood allowed to coagulate, when the wound is fresh. The orthodox rag and mutton tallow usually applied to such wounds is an effectual bar to the scabbing process.

Lacerated wounds, as the name implies, are produced by *tearing* the skin and the parts underneath, and may be of any extent, from the mere scratch of a pin to a laceration bounded only by the size of the body. Certain kinds of machinery produce the worst examples of this kind of injury, as, for instance, "planers," "irregular moulders," and that most savage of all implements, the circular saw. The writer a few years since treated the case of a man who fell nine feet, upon a large circular saw, revolving at the rate of 1,500 times per minute. He was tossed about in the most helpless manner for an instant and then thrown with great violence against a brick wall. He received no less than sixteen different wounds, most of them very deep, besides a fracture of the skull; and yet such is the recuperative power of nature, that the patient, who was luckily a temperate man, recovered entirely. Notwithstanding the number and extent of these wounds, he lost very little blood, for nearly all were lacerated wounds, which do not as a rule bleed much, as the arteries are torn irregularly, instead of being cut clean across, and a clot very soon forms which effectually prevents further loss of blood. Had one-fourth of the wounds been made with a sharp cutting edge, instead of the "ragged edge" of a dull saw, the man must have perished from loss of blood, before the arrival of help.

Treatment.—The treatment of lacerated wounds is in some respects like that of incised wounds. The first thing is to secure absolute cleanliness, removing with a gentle stream of water and a soft sponge all dirt, hair, bits of skin or muscle that are entirely separated, and then the torn skin should be dried with a soft napkin. This is essential, for a mere scratch, if irritated by the presence of a particle of dirt, may take on inflammation, which, spreading from the finger up the arm, will cause intense pain, while a deep abscess may form near the wound. Should this happen in spite of your care, it should be treated in the same manner as directed for a collection of pus at the bottom of a punctured wound, viz., poultices, leeches, and incisions. When the wound is cleaned and dried it should receive some kind of support from strips of plaster or a compress and bandage, but the parts should not be drawn tightly together, and a space should be left between the strips of plaster to permit the escape of fluids which may fill the cavity. The surface may be covered with wet lint or fine oakum soaked in a mixture kept in all drug stores, called "carbolized oil." (See Vol. II.) The parts should be well raised and kept at rest. In lacerated wounds of the hands and feet, it is surprising to find how well the parts heal under this treatment, and how large portions of skin that have been nearly torn from the body, when carefully put in their natural position, unite with the sound skin and retain their life. When the parts are so injured that the death of the detached bit of skin is feared through the want of sufficient blood, it is well to wrap the whole limb in cotton-wool and even to apply heat by means of hot, dry flannels. The writer once saved the right thumb of a mechanic, by fastening it in its place after it had been severed by a fine circular saw, bone and all, so that it hung by a shred of skin about one-third of an inch in breadth, and cases are well authenticated where a finger has been entirely severed, but having been replaced at once and stitched on or fastened with plaster, it has regained its vitality and proved a useful member. The moral of this is obvious —preserve every bit of skin that is attached in any way to the sound integument. This is especially true in lacerations of the scalp, and no fragment should be removed if attached even by the merest point to the sound scalp, for such injuries are very readily restored in this part of the body; but remember that, to insure success, the torn part must be accurately readjusted and held there in some way, and heat applied to increase the flow of blood to the injured part. It frequently happens that small bits of skin are torn or gouged or pinched from the person in some way, so that a perfectly raw and bleeding surface is left without its natural

covering. These are the cases where we can reasonably hope to see the parts heal by the "scabbing process," and this can be secured by allowing the blood to dry gradually and form the film spoken of heretofore, or a little lint or linen scrapings can be soaked in the blood, as it exudes from the wound, placed upon the raw surface and secured there either with sticking-plaster or a bandage. Such dressings should not be disturbed for a week at least, or until they are loosened and ready to come off without the application of any force. Should the scab fail to develop and the wound show the usual signs of inflammation, viz., heat, pain, redness, and swelling, the dressings should be soaked in warm water until they can be easily removed, and then a poultice should be applied and renewed until the wound assumes a healthy appearance, when it may be dressed with cosmoline, or simple ointment, and covered with a linen rag.

Contused Wounds.

Contused wounds, as the name implies, are divisions of skin and flesh with more or less bruising of the parts, and with loss of substance to a greater or less extent. The simplest form of contusion is indicated by the presence of the *blood-blister*, and is the result of some slight injury which breaks a blood-vessel beneath the skin without dividing the skin itself. The blood, in such a slight contusion, is poured into the fatty tissue which lies between the skin and the red flesh, from whence it is either absorbed and disappears in a short time, or else it gradually dries up and becomes consolidated with the dead tissues above it, and eventually scales off, leaving a new skin underneath. It sometimes happens that blood-vessels break beneath the skin, forming a dark-colored spot resembling an ordinary bruise, or it may assume the intense redness occasionally seen in the white of the eye, under the outer covering, while no soreness or pain is experienced by the patient. This blood is gradually taken up and the eye resumes its natural appearance. This accident has no importance whatever, and unless there is pain in the affected eye no treatment is needed. These bruises without perforation of the skin are not always such slight affairs, for occasionally we see a contusion which not only causes an immense "black and blue" spot or "blood-blister," but in which the underlying parts are irretrievably pulpified and disorganized. Sometimes, also, it happens that a large quantity of blood is poured out under the skin from a contusion, which cannot be absorbed, and, by its pressure, causes great pain. When the parts about a contused wound are broken or torn, the edges

are irregular and rough, while there is less gaping than in either incised or lacerated wounds owing to the fact that the force of the blow destroys the vitality of the injured skin and muscle, therefore there is less contraction. There is but little bleeding, for the same reason that holds in lacerated wounds, viz.: the artery having been torn or bruised instead of cut, its roughened end favors the early formation of a clot, which soon occludes the entire vessel.

Treatment.—The treatment of contused wounds of this character is very similar to that already given for lacerations, simply bearing in mind that the cleansing process should be especially thorough, because there must be a destruction and throwing off (sloughing) of a certain amount of skin and of parts underneath, and this destructive process should not be aggravated by the presence of any foreign substances. This can be accomplished with the soft sponge and tepid or cold water, aided by the fingers and tweezers. Bleeding to any considerable extent is rare in these wounds, but if it does occur, it can generally be controlled by the application of ice or cold water, or if these fail, try some of the methods heretofore advised in the section upon bleeding. In selecting a dressing for an open contusion, remember that some inflammation must ensue, and that you must make no attempt to bring the edges together or to hold them by means of adhesive strips.

One of the oldest is one of the best applications for these wounds, viz.: compound tincture of benzoin (see Vol. II.). It not only coagulates any blood upon the surface, but it seals up the wound thoroughly, and of course protects it from any poison that may be floating in the air. It can be painted on with a feather and renewed once or twice daily, and can be covered with a linen rag slightly smeared with oil or mutton tallow to prevent adhesion, or the wound may be left with no other covering than the film caused by the benzoin.

Carbolized oil (see Vol. II.) may also be used upon this kind of injury, covered either with lint or rag; or cosmoline (see Vol. II.) may be applied in the same manner. If there is no pain or bad smell it will not be necessary to interfere with either of these dressings, except to renew them as required, but the wound should remain unopened until the scab which has formed drops off and leaves the scar visible; but if there is pain, or if a foul-smelling matter oozes out, then the wound should again be thoroughly cleansed and the omnipotent poultice of flaxseed applied and renewed very frequently until the sore assumes a healthy appearance, when it may be treated like any open sore which is healing by secondary repair or "granulation."

A very distinguished surgeon advises that all lacerations and

open contusions be treated with poultices, oiled lint, or wet rags from the first, and says if the wounds are not too deep they will heal at once without the formation of pus or the presence of granulations. It is proper to state that as a matter of fact these wounds usually heal by the granulating process, and require the same care in preserving cleanliness and in dressing as do open or lacerated wounds. It sometimes happens that these granules are slow in forming, indolent as it were, and then it is well to stimulate them to greater activity, which is effected by brushing the surface of the sore with a wash made by dissolving a bit of blue vitriol as large as a pea in half a coffee-cup of soft water. The granulations may be brushed with this every day or two until they assume a healthy red color and give evidence of renewed growth.

In cases of severe contusion, without rupture of the skin, where a considerable quantity of blood has been poured out underneath the skin, or where the blood has been effused from spontaneous rupture of a vessel, there are three things to be accomplished by treatment, viz.: to check further bleeding, to prevent inflammation, and finally, to restore the use of the parts. The bruised part should be placed in a raised position, and cold water or ice should be applied at once; these measures, with rest and plain diet, and perhaps a Rochelle or Seidlitz powder (see Vol. II.), will check the bleeding and restrain inflammation. A bandage applied, or stimulating liniments well rubbed on, after the tenderness has subsided, will promote absorption of the blood and will restore the parts to their natural condition.

In that most disreputable contusion, a "*black eye*," the application of brandy with a brush kept up for a long time, or even alcohol, will often prevent the further effusion of blood. It is said that a strong solution of alum or tannin will effect the same result. Raw beefsteak is a popular remedy of very apocryphal virtue. [A solution of nitrate of potash (saltpetre), made by dissolving a teaspoonful in half a cupful of water, will help to change the dark color to a brighter red. It may be applied by means of a piece of folded muslin, which must be kept wet with the solution. See, also, section on **Bruises** in this chapter.—Ed.]

Poisoned Wounds.

Poisoned wounds include not only wounds which receive the poison when the injury is inflicted, but also wounds or scratches originally healthy, but which have been poisoned by contact with irritants, such as acids or alkalies, or by contact with the morbid

fluids from animals that have died from disease. Wounds from the bites and stings of healthy animals and insects, and wounds from diseased animals or inoculation from their blood, are all considered and treated as poisoned wounds, differing in degree rather than in character. It is the poison that renders the wound painful and dangerous, rather than the mere division of the skin. Thus the perforation made by the proboscis of the musquito is smaller than the wound made by the point of a needle, and yet the latter causes a momentary annoyance only, while the former will burn and itch for hours, besides causing a swelling and inflammation that is perceptible for a long time. In this country we have but few reptiles whose bite is poisonous, and the stings of our native insects are usually followed by only temporary results, so that the wounds of this character most commonly seen are caused by the bites of domestic animals and the absorption of poison by wounds or scratches previously existing.

Putrefying Animal Matter.

The most common instance of this variety is the dangerous "dissecting wound," contracted by medical students while working upon the dead body, or by physicians while making post-mortem examinations. As a rule the fluids of all dead animals become poisonous after decomposition has begun, and the greatest care should be exercised in skinning oxen and other animals dying from disease or accidentally killed. The slightest scratch upon the hand, or a "hangnail" upon the finger, may absorb poison enough to endanger life, or the operator may inoculate himself by a careless use of the knife, bathed, as it is, in the most deadly of fluids. Another source of danger in skinning or handling dead animals, arises from the presence of the "flesh-fly," of which there are several varieties, ranging in size from the enormous "blue-bottle" to an insect smaller than the house-fly, but which is armed with a double-edged lancet so sharp and so pointed that it will penetrate the thickest skin. The danger from this source can best be illustrated by an instance that came within the personal knowledge of the writer.

Many years ago a farmer in New Hampshire, upon visiting a distant pasture, found an ox which had been killed by lightning. Putrefaction had commenced, but the thrifty farmer secured the assistance of a neighbor, and the two men removed the skin from the animal. The flesh-fly was present in great numbers, and in the course of the afternoon both men were bitten by them—one upon the lip and one just under the eye. Within twenty-four

hours a most painful swelling had developed in both cases, accompanied with great prostration and fever. A surgeon was called, who made free incisions into the swellings and applied strong nitric acid (aqua fortis; see Vol. II.), but to no effect, for both men died within four days from the time they were bitten by the flies, which had previously been feeding upon the putrid fluids from the dead ox. The disease produced by such an apparently trivial cause is called "*malignant pustule*," but is sometimes described as "*malignant carbuncle*," and although it is fortunately of very rare occurrence, it is as much to be dreaded as the deadly bite of the rattlesnake. A noted German writer upon surgery asserts that malignant carbuncle may arise from mere contact with the fresh or dried skins of cattle which have died from carbuncle, the poison being absorbed directly, although the hands are free from scratches or cuts of any kind. The same writer, and other equally reliable, state that the pustule or carbuncle may result from the bite of flies which have previously alighted upon the nose of a horse suffering from "*glanders*, or *farcy*," and it is generally understood by horse-breeders that the fluid which is so plentifully thrown off in glanders is highly dangerous in two ways: first, the disease itself may be communicated to man by a careless use of cloths, or even by wiping the face with unclean hands; and secondly, a healthy wound may be converted into a poisoned one by contact with this fluid directly.

Treatment.—The treatment of poisoned wounds, especially if very large or virulent, requires an amount of skill rarely found outside the medical profession, for the reason that besides mere local measures, strict attention must be paid to the treatment of the very dangerous constitutional symptoms that usually ensue. This is eminently true in the management of the malignant pustule, which, as heretofore stated, sometimes results from inoculation with the morbid fluids of both dead and living animals. Of course no layman would attempt to treat such a deadly malady if a physician were within reach, but as such a contingency might occur in the absence of a physician, a few plain directions may not be out of place. If the pustule develops from the bite of the flesh-fly, or from a mere prick with the point of a knife which has been used about a dead animal, then the disease first appears as a highly irritable and painful pimple or boil surrounding the inoculated spot. This should be opened at once with a sharp penknife, being sure to make an incision entirely through it, and it is always safer to make two free cuts crossing each other, so as to lay open the whole pustule. When the bleeding has ceased the wound should be thoroughly dried with lint or soft rags, and a thick layer of some

ointment, or even lard mixed with beeswax, spread upon the sound skin around the pustule. Then a little mop of soft rags, fastened to the end of a stick, is to be thoroughly wet with nitric acid (aqua fortis) and pressed steadily upon the raw surface of the pustule. Undiluted carbolic acid is sometimes used instead of the nitric, even when both are at hand ; sulphuric acid (oil of vitriol) is a powerful caustic ; arsenic in powder, mixed with a little flour and wet with a few drops of water, may be applied as a paste ; tincture of iodine, or, better still, the crude drug itself ; creosote, in the absence of all the above, may be used ; but better than either of the last three mentioned is a bit of iron as large as a "tenpenny" nail, heated to a white heat and freely applied. If the iron is really brought to a *white* heat, it is the least painful of any of the caustics. A constant stream of water should fall upon the wound, of any degree of warmth most comfortable to the patient, and this can easily be effected by an arrangement of rubber tubing, or by a bit of wicking immersed in a vessel of water, with one end hanging over the wound. The patient will need twenty-drop doses of laudanum or teaspoonful doses of paregoric often enough to partially relieve the pain, while he should be fed most generously with milk, cream, eggs, and beef-juice, and stimulated with brandy, wine, or any kind of spirit. If the poison from a dead animal, or from a horse with the glanders, inoculates a previously existing wound, the treatment is mainly the same, only there is no need of using the knife, as the surface is already exposed. As prevention is better than cure, should a person who has been exposed to inoculation discover soon after that he has a scratch or cut, or "hangnail" upon his hand, it is best to allow a stream of cold water to flow over it for a long time, and then he should touch the suspected spot with a stick of lunar caustic, wetting it slightly and pressing it well into the wound. As this caustic merely forms a film over the raw surface, it is not applicable where the pustule has developed, but here it answers a good purpose. This caustic is so valuable as a protective agent, that every one who has to do with animals, living and dead, should always carry a little bit, properly guarded, in the pocket, and whenever a scratch or any abrasion of the skin upon the hands is noticed, at once apply it as directed. Thus protected, one can handle the most putrid substances with comparative impunity. Another and simpler method, where there are no considerable wounds of the skin, is to bathe the hands freely and often in some kind of oil or grease, while engaged in skinning or "rendering" an animal that has died from disease, or in which putrefaction has commenced.

Stings and Bites of Insects.

A common form of poisoned wounds in this latitude is that caused by the *stings of bees* or *wasps*. These, singly, are not dangerous to life, unless the throat or back part of the mouth be stung by one of these insects, concealed, perhaps, in ripe fruit, and then the danger arises from the swelling, which may cause death by strangulation. Stings near the eye are very painful, and are sometimes followed by troublesome inflammation. A large number of stings inflicted at the same time may cause death by shock, as in the case of a child in Vermont, who overturned a bench upon which were standing four hives of bees. The child's head, neck, hands and arms were instantly covered with the infuriated insects. The pain was at first terrible, but it soon subsided, and she died in a few hours from collapse following the shock. Animals are not unfrequently killed in the same manner. The writer remembers seeing the bodies of a span of fine carriage-horses, which had been tied near an apiary containing several hives, the inmates of which made a combined attack upon them, stinging them about the head and eyes and adhering to them in their mad race of more than a mile to the stable where they were kept. One of the horses died in about six hours, while the other lived for more than twelve. The sting of an insect of this class is always followed by swelling, inflammation, and a peculiar, but very severe pain. If treated properly and promptly, the pain ceases in a very short time, while the swelling subsides more slowly. The bites of few insects in this country are followed by serious results. In the northern portion of the Union there exists a small *black spider*, which constructs no web, but which leads a wandering, predatory life, "foraging for grub," as Sherman's soldiers called it—wherever blood is to be found. This insect is rarely seen by the person attacked, as it

FIGURE 237.—The lancets and sheath of the sting of a bee. The object at the upper portion of the illustration is the poison-bag, from which, by the action of muscles, the poisonous fluid is injected into the puncture made by the sting.

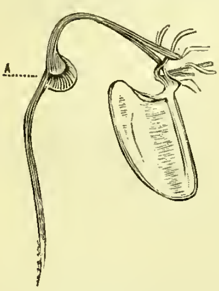


FIGURE 236.—The lancet of the wasp.

usually bites while the victim is sleeping, and the slightest motion will cause the spider to depart in a series of leaps that carries it instantly beyond the reach and vision of the sufferer. This "hunting spider," as it is called, is usually found in old houses or about dead and rotten logs and trees, and sometimes will attack one who is awake, provided the person keeps perfectly still. The writer has treated a case of bite by this spider in which the results were intense pain, swelling, heat, and redness, followed by an abscess, which discharged a large quantity of matter. The large spider of the Southwest, called the *tarantula*, is as venomous as it is ugly in appearance, biting whoever disturbs it. The inflammation, swelling and pain, and the constitutional depression following the bites of spiders, is more severe than similar symptoms from the sting of any insect, the *scorpion* alone excepted; but fortunately they are of rare occurrence, and are usually unattended with danger, if the treatment is prompt and judicious, as heretofore remarked.

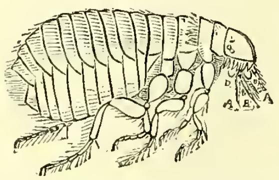


FIGURE 238.—(After PACKARD).—The Flea (greatly enlarged).

The lancet of the *mosquito* consists of six bristle-shaped organs, which are folded together, when not in use, within a gutter-shaped sheath. The six "bristles" are together, and with little apparent effort thrust into the skin, and the blood is drawn through the channel formed between them. According to Dr. A. S. Packard, Jr., no poison-glands have been demonstrated to exist in the head of the mosquito, flies, or other six-footed insects, and this authority questions whether the irritation is not produced by the barbed character of the organ rather than by the presence of a poisonous fluid.

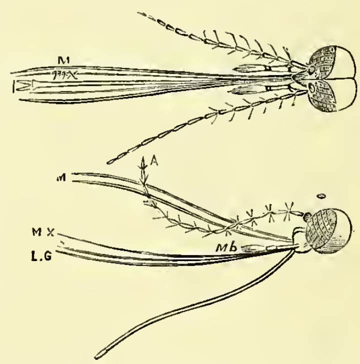


FIGURE 239. (After PACKARD).—The lancet of the mosquito, greatly enlarged. *M* in both figures indicates the bristles forming the lancet. The central object, in the upper figure, is the gutter-shaped sheath which holds the lancet when not in use.

The *Cimex lectularius*, or *bed-bug*, is one of the most widely-distributed pests of the human race, and is the cause of much annoyance among adults and suffering among infants. Unless scrupulous cleanliness is enforced, the use of vermin-powders will be of but little aid in preventing its increase when it once finds lodgement. The most destructive foe of the bed-bug is the cockroach, by which large numbers are destroyed. Fumigating a house with brimstone, as directed in Vol. II., will exterminate

them, and so will a mixture of three parts of unpurified petroleum with one hundred parts of water. The latter must be introduced into all holes and cracks in houses, while bedsteads ought to be scalded with boiling water, and then the cracks should be smeared with mercurial ointment. Instead of the scalding (which is likely to injure varnish), a spray of benzine, produced with an atomizer (see Vol. II.), may be thrown into every crevice; but while using it there must be no open light near, on account of the risk of explosion. It has been stated, for the benefit of travellers, that when a light—even a dim one—is kept burning through the night in a bed-room, bed-bugs will not venture from the crevices in which they hide themselves during the day-time.

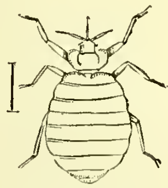


FIGURE 241. (After PACKARD). The Bed-bug (enlarged).

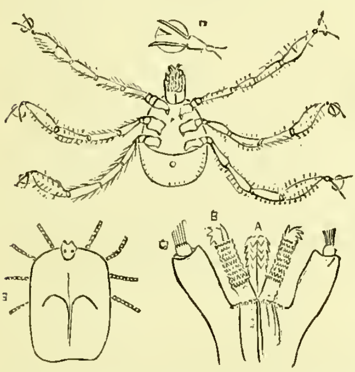


FIGURE 240. (After PACKARD.)—The Tick (magnified). The figure at the left lower corner is the shape of the fully-developed tick, the illustration on the right side being a more magnified representation of the toothed jaws by means of which the tick retains its hold.

More or less common in all parts of the United States, and very numerous in the tropics, are found a variety of *ticks*. They are most common in woods, where they attach themselves to the skins of animals, and frequently to human subjects. They bury the head in the skin and then gorge themselves with blood. Their presence does not generally cause much irritation beyond simple itching, and if left they will die after a few days. Their removal is not easy, owing to their grapnel-like jaws, which enable them to hold on in spite of considerable force; but, by seizing them with forceps, the body may be pulled away, and with the aid of fine tweezers, and nicking the edge of the opening in the skin with a penknife, the head can be extracted.

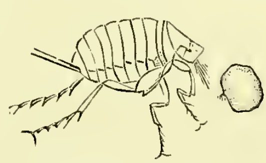


FIGURE 242. (After PACKARD).—The Chigoe, or Jigger. The smaller, globular figure represents the female insect of natural size, with the abdomen enormously distended with eggs.

A very common torment of tropical America is the *Chigoe*, Jigger, Bicho, Chique, or Pique, as it is called by the natives. The adjoining figure shows the insect very much enlarged, and the gravid female of natural size. The female, during the dry season, bores into the feet of the natives, the operation requiring but a quarter of an hour, usually penetrating under the nails, and lives there until her body becomes distended with eggs, the abdomen swelling out to the size

of a pea. The presence of the insect often causes distressing sores, and the best preventive consists in cleanliness and the constant wearing of slippers or shoes when in the house, and boots when out of doors.*

The *Black Fly, Punkey,* or *Midge,* found in the woods of the Northern States and on the Western prairies (where it is called the Buffalo-fly), is an intolerable pest at some seasons of the year. It is very small, and cannot be scared away like the mosquito. In Illinois it has been known to plague horses to death, and in Hungary, where it also abounds in immense numbers, it often kills cattle. Hunters resort to various measures to prevent its attacks, of which the following are among the best known :

Figure 243. (After Packard.) The Midge, or Black Fly, considerably magnified.

A smouldering fire of chips, called a "smudge," is so placed that the wind will blow the smoke about the camp. This is an effectual preventive of the attacks of mosquitoes as well. Exposed parts of the body may be greased with an ointment of one drachm of the oil of pennyroyal added to an ounce of simple cerate, or lard. Or equal parts of wood-tar and sweet-oil may be applied at intervals during the day to the face and hands. The latter preparation is easily washed off with soap and water, and has the additional advantage of preventing sun-burn.]

The Treatment of the stings of bees and wasps is usually a very simple affair, where, as it generally happens, there is but one wound. The domestic remedies most commonly used are the application of a *cool* poultice of raw mashed potatoes, clay, or loam moistened with water, cabbage-leaves previously pounded or rolled, and sweet oil. Sometimes dry applications, like flour or chalk, are used. These answer the purpose in most cases ; but occasionally a person is stung who is very susceptible to the effect of such injuries, and excessive inflammation, swelling, and pain develop about the wound, while there is considerable sympathetic fever. In such cases the best application is ammonia-water or sal volatile applied until the severity of the symptoms have abated, when it may be covered from the air with the cool poultice or a cabbage-leaf, or even a bit of oiled silk. If the ammonia or sal volatile are not at hand, a little cooking-soda, slightly moistened, or some damp table salt will answer a very good purpose. A half-teaspoonful of sugar of lead dissolved in a teacup of cold water makes a very grateful application. In some cases the sting is

* A. S. Packard, Jr., "Guide to the Study of Insects."

left in the wound, and when thus it happens it should be extracted with tweezers before any local application is made. When the sting is inflicted upon the inside of the mouth, throat, or on the tongue, it is a much more serious affair, and the treatment should be very prompt. If the sting remains in the wound, it should be removed if possible, as its presence adds greatly to the danger of suffocation, and then the patient should use hot salt and water as a gargle, alternated with hot vinegar and water, while the neck should be enveloped in cloths wrung out in hot water and renewed very often. If this does not afford immediate relief, the swollen part should be pricked or cut in several places with the point of a sharp penknife, and the same gargles continued, in the hope of reducing the swelling by causing a copious flow of blood and saliva. Leeches may be applied if possible, but this is very difficult. If all these measures fail, life can only be saved by making an opening into the windpipe, but of course this must be done by a surgeon. If a person is stung in many places at the same time, the relief of the excruciating pain is the first indication, and here the ammonia-water must be used very freely, while twenty drops of laudanum or a teaspoonful of paregoric must be given at intervals of forty or sixty minutes until the intensity of the pain is relieved. In this case the weak lead-wash makes a very good application, as does also the moistened soda or salt. In an emergency, where the lead and ammonia are not to be had, cologne-water, or vinegar diluted with water, may be used, and the common soap liniment or "opodeldoc" may be freely applied after the pain is partially relieved. As the physical depression which follows a number of stings is very marked, the patient should take cordials and stimulants very freely until the pulse at the wrist becomes firm and steady. As a rule in such severe cases, the remedies mentioned are to be used to save time and suffering while a messenger goes for the nearest intelligent physician.

The bites of spiders are treated upon the same general plan already given for the stings of bees, bearing in mind the greater severity of the spider-bite, and the fact that they are more likely to be followed by abscess. The old writers, who indulged in a great deal of romancing concerning the bite of the Tarantula and other large spiders, say that the swelling, lividity, and cramps which follow these injuries were best treated by free scarifications and wine. This would be very judicious treatment, even now, for such symptoms; but, fortunately, our native spiders, with two or three exceptions, are neither large nor venomous. The bite of the "hunting spider" should be treated with the ammonia-water or lead-wash, and if an abscess results, as sometimes happens, it

should be poulticed until "ripe," and then opened with a sharp-pointed knife. When prolonged inflammation or abscess follows the bite or sting of any insect, the system must be supported with some cordial or stimulant; and when wine or spirit is objected to, a capital substitute is found in Huxham's tincture of bark [Dose, one to four teaspoonfuls]. A grain or two of quinine may be administered three times daily, in addition to the wine or brandy. For sudden depression or partial collapse following a severe wound, or a number of wounds of this character, no better stimulant can be given than the spirits of ammonia (twenty-five drops to a teaspoonful) diluted with water, and frequently repeated. This remedy is the sheet-anchor with many physicians in the treatment of all kinds of poisoned wounds, and its administration should be continued until the patient is either out of danger or beyond help. It is so valuable that a small vial of it ought to find place in every family medicine-chest.

Scorpion and Centipede Bites.

Before leaving this subject altogether, it is proper to mention that although the ordinary wounds inflicted by insects have been mentioned, there are two species found in the Southern and Southwestern States of the Union, the bites or stings of which are much

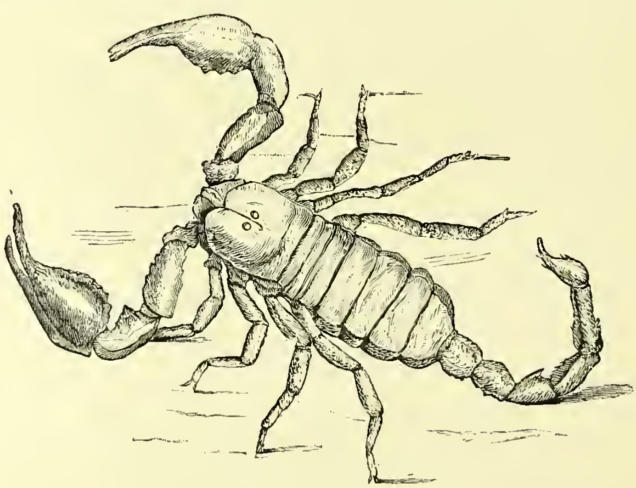


FIGURE 244.—The African Scorpion.

dreaded by strangers. I allude to the *Scorpion* and the *Centipede*, the former inflicting a sting which has many of the properties of that of the bee and wasp, although much more active. The wound is comparatively harmless, the only effect being a tolerably smart,

but transient inflammation. In Asia and Africa this animal attains a large size, and its sting is followed by great suffering, and even loss of life. In those countries the great remedy is olive oil, and an idea prevails that its virtues are increased by steeping in it the bodies of scorpions previous to its application. The wound caused by the sting of our native scorpion is best treated by the applications already recommended for the stings of bees and wasps. Should the symptoms not yield promptly to such mild measures and the wounded parts take on excessive inflammation or great swelling, it should be well washed with salt and water, then pricked in several places, or slight cuts made with a knife, and bleeding encouraged by the application of hot water, and the whole covered with a thick, hot poultice. If the system is much depressed, the patient should take brandy and ammonia, while laudanum or paregoric can be given to relieve pain.

The bite of the *Centipede* is a much more serious matter, as the animal often attains a length of five to seven inches, and its assault is occasionally followed by severe symptoms, and even death. The poison-bag is lodged within the jaw, and the bite is exceedingly painful, and is followed by swelling and discoloration, along with fever and delirium. In one recorded case the patient only survived the bite about six hours. The most approved treatment

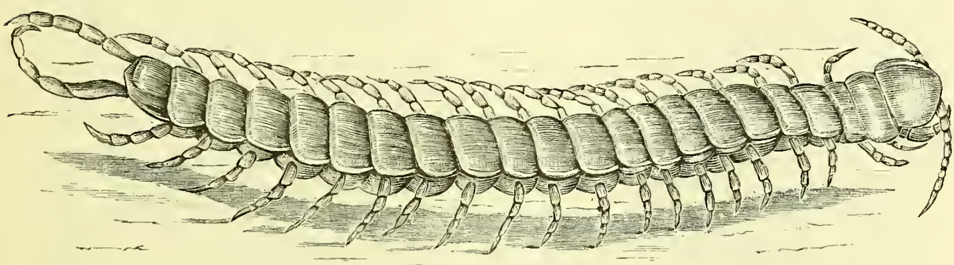


FIGURE 245.—The Centipede, natural size.

for these bites is the application of ammonia and alcohol to the surface, while both should be given internally, with laudanum to allay pain.

As the extraction of the poison is of great importance, the wound should be immediately enlarged with a sharp knife until the blood flows freely, and then sucked for a long time, as this poison, like that of the rattlesnake, is harmless when taken into the stomach, unless there should happen to exist an abrasion of the lips or a sore of any kind within the mouth. A good substitute for this mode of extracting the poison, and perhaps preferable to it, is the cupping-glass, which is very easily applied. Take a common

tumbler, or even a teacup, and throw into it a bit of lighted paper or a lock of cotton wet in alcohol. Then, while burning briskly, place it bottom up over the wounded part, and hold it there firmly until the fire is extinguished, which will occur in a few seconds. Thus, by creating a partial vacuum, the flesh will rise perceptibly under the tumbler, which draws upon it very strongly and causes the blood to flow freely. This is a very simple and safe substitute for "sucking" any kind of poisoned wound, and is absolutely painless, as the lighted paper is burned out before the skin can be scorched in the slightest degree.

Snake-Bites.

We have in this country but few serpents whose bites are followed by dangerous symptoms. In the extreme south and southwest there are a few reptiles which seem to be universally dreaded, such as the "*moccasin*," the "*chicken snake*," and the terrible "*king snake*," which last, by the way, is not a true snake, but a species of lizard, with the feet situated near the extremities. The one venomous reptile which is more or less abundant throughout the entire continent, and under whose fangs a hecatomb of victims have perished, is the *rattlesnake*. So much nonsense has been written concerning this animal, that until recently it has been difficult to distinguish fact from fiction; but in 1868, Dr. S. Weir Mitchell, of Philadelphia, gave to the world the results of a series of observations and experiments, which have effectually solved all doubts concerning this reptile. He has shown that this snake cannot poison itself, and that it is not unlike other reptiles in this particular. Dr. M. has also shown that the poison-virus has no effect upon the mouth or stomach, and that it may be swallowed with impunity. Its specific effect is to weaken all the tissues under the skin, so that the blood-vessels give way, and the blood, which becomes unnaturally thin, is poured out, forming large discolored spots. He divides the effects of a bite into two stages: during the first the symptoms are vomiting, deadly coldness, irregular and faltering pulse, the skin either livid or yellow, bleeding from the nose, fainting, convulsions, and delirium. Meanwhile the bitten part swells immensely and becomes mottled with effused blood. Sometimes there is excruciating pain and sometimes complete numbness. If the victim does not die in this stage, he passes into the second, during which large abscesses form in the swollen parts, filled with bloody, unhealthy pus, and which are attended with low fever. After death the body putrefies rapidly. With this frightful train of results it is easy to conceive that districts infested by this snake would be

depopulated ; and this would undoubtedly happen were it not that its rattle is invariably sounded before the attack, thus giving time and opportunity for escape.

It is a singular fact that the rattlesnake's bite has no effect upon swine, owing probably to the thick layer of fat about the head and neck. A hog has been seen to attack, kill, and eat them, apparently not at all incommoded by the bites received in the combat. A contractor who constructed the railway between Niagara Falls and Detroit, told the writer that a large gang of Irish workmen were driven from a certain locality on the line by rattlesnakes, which were very numerous and decidedly aggressive. Following the advice of a Canadian farmer, the contractor procured a drove of swine, which were driven upon the infested spot and kept there for several days without food, watched by outlying sentinels to prevent them from straying beyond certain limits. The cure was radical, as the hungry hogs sought out and devoured nearly every snake upon several acres of rocky ground. Early in September, at the latest, this snake sheds its entire skin, even to the covering of the eyes, and appears in all the glories of a new dress. While the old skin is becoming detached from about the head, the snake is entirely blind and will strike in the direction of any sound near it, and this is the explanation of its being so much more dangerous in the month of August.

The weapon with which this animal does its deadly work is not a true tooth, as is generally supposed, but is a fang—or rather a pair of them—which lie concealed under a fold of the mouth-lining, and are never used except as offensive weapons. They are never seen unless the snake is irritated, when they are instantly raised and darted forth with great force into the skin of the person attacked, and at the same instant the poison is injected through a canal which runs upon the outside of the fang. The snake, according to Dr. Mitchell, does not *bite*, but *strikes*, making a punctured wound. The effects of the wound vary according to the situation of the part, the acrid character of the poison, and the age of the patient. Many persons bitten either escape altogether, or suffer slightly, the poison either not reaching the tissues which would absorb it, or being too inert to act. Adults suffer less than children, because, as is supposed, they possess greater vigor of constitution. The poison is much weakened, if not destroyed, by a rapid succession of bites, while wounds upon the extremities are less dangerous than those upon the trunk. Notwithstanding these exceptions, so many persons have died from this cause, that it is more dreaded than any accident that can happen to man, with one exception, to be mentioned hereafter. The

time that elapses between the bite and the fatal termination varies very much. One man bitten in Baltimore died in twenty-eight minutes. A person in New York City died in forty minutes after receiving a bite upon the forefinger. Dr. Wainwright, also of New York, lost his life in six hours after being bitten upon the middle finger. Instances are recorded where death has ensued at all periods from one day to six weeks, which makes it probable that in the first series of cases the fang penetrated a tolerably large blood-vessel, so that the poison made the circuit of the circulation in a few minutes, thus inoculating the whole system.

The bite of the "water-moccasin" or "cotton-mouth," and the "copperhead," are quite as deadly as the bite of the rattlesnake, and in the South are even more dreaded, as they give no warning of their presence, and attack everything that comes within reach.

The Treatment of the bite of the rattlesnake will serve as a guide to the treatment of the wounds inflicted by the other varieties of snakes mentioned, as the former are much the most common, owing to the wide distribution of that particular serpent. Much has been said and written concerning the cure of these bites, and the public press and even scientific journals occasionally announce the discovery of some specific that is to render the venomous stroke of the rattlesnake as harmless as a bee-sting, Within ten years the newspapers gave a minute account of a so-called "snake-stone," which had the power of extracting the poison from such a wound, adhering to it by some unknown force, and dropping off when saturated with the virus from the bite. It could then be soaked in vinegar until its original color was restored, when it was again fit for use. One of these invaluable stones was said to be in possession of a Virginian, who received it as an heirloom from his ancestors, and that he had cured numbers of persons who had been bitten. It was still further stated that the quarry from whence the stone was originally obtained had been discovered in the mountains of North Carolina, and that preparations were making for mining it upon a large scale. Of course the whole story was either a fiction founded upon a *supposed* fact, or else it was the first step in a deliberate plan to defraud.*

* ["MR. HARDY describes the 'snake-stone,' or *piedra ponsonæ* of Mexico, as being made and used in the following manner:—'Take a piece of hart's horn of any convenient size and shape, cover it well round with grass or hay, inclose both in a thin sheet of copper well wrapped round them, and place the parcel in a charcoal fire till the bone is sufficiently charred. When cold, remove the calcined horn from its envelope, when it will be ready for immediate use. In this state it will resemble a solid, black, fibrous substance of the same shape and size as before it was submitted to this treatment.

In Europe the "Eau de Luce" was regarded as a certain cure, and until quite lately, a remedy called "Bibron's Antidote" was relied upon, even by physicians, as a sure means of neutralizing the effects of the injected poison of the rattlesnake. Dr. Hammond, of New York, once prescribed a mixture similar to Bibron's, and this neutralizing virtue has also been claimed for a solution of arsenic ; but Dr. Mitchell has proved conclusively that none of these medicines possess any such virtues. Professor Halford, of Australia, injects the water of ammonia into the veins of a person bitten by the serpents of that country, and claims that it cures in every case. Its use in America only proves that the virus of the Australian snake is less active than that of the rattlesnake, for it has failed completely here. As the case now stands, it would seem that there is no known antidote or cure for the bite of some of our native snakes, and the victim of an attack must depend upon the knife, ligature, and cupping-glass, or trust to the chance afforded him by heroic doses of whiskey—and prudence would dictate the use of all these means.

The first thing to be done when bitten is to put a cord *above* the wound, *i. e.*, between the wound and the heart, to prevent the poison from making the round of the circulation. This must be done at once, and with the best substitute for a cord that can be procured instantly. A leather strap, a cravat, a shoe-string, a handkerchief, or a strip torn from the clothing, must be put about the limb and drawn as tightly as possible. If any doubt exists as to the efficiency of the ligature used, put on another above it ; and even then it is well to get a stout stick under the cord, and, by twisting it as directed in the section upon "Bleeding," get a still firmer pressure to bear upon the blood-vessels. Next, if possible, cut out the part bitten with a pen-knife, being sure to cut deep enough. Do not think of the injury done the limb by the cut, but remember that life itself depends upon your courage, and then use the knife freely and quickly. I have seen it recommended to insert a small stick or stalk of grass, or a straw into the puncture made by the fang, and use that as a guide to the knife, cutting around and below it, making two incisions in the shape of an ellipse, thus  The wound should then be sucked thoroughly, or, if possible, apply the cupping-glass or tumbler, as heretofore di-

Use.—The wound being slightly punctured, apply the bone to the opening, to which it will adhere firmly for the space of two minutes, and when it falls it should be received into a basin of water; it should then be dried in a cloth, and again applied to the wound. But it will not adhere longer than about one minute. In like manner it may be applied a third time ; but now it will fall almost immediately, and nothing will cause it to adhere any more.'"—FAYRER, "Poisonous Snakes of India."]

rected, sucking or cupping for some minutes, when the wound should be bathed in hot water to encourage bleeding. Remember that the wound cannot be sucked with safety if there is any sore or abrasion upon the lips or in the mouth, and hence the cupping-glass is most desirable where it can be used to advantage. Instead of this, if any strong ammonia or caustic potash or nitric acid is at hand, the fresh wound may be freely cauterized; or, better still, it may be thoroughly burned out with a hot iron, where the bite has been simply cut out and sucked, or cupped.

Dr. Gross advises the free application of tincture of iodine, as soon as it can be obtained, over all the parts surrounding the bite. Where the patient is so situated that the part cannot be cut out, Dr. Mitchell recommends the use of the "intermittent ligature," as he aptly calls it, which simply means relaxing the cord about the limb for an instant; then drawing it tightly again, and repeating this often enough to prevent injury to the parts below the cord. By this means he lets only a little of the poison into the general circulation at a time, and, by stimulating the patient freely, he thus fights the enemy in detachments, instead of encountering the accumulated force of all the virus.

This brings us to the great American remedy, or "Western Cure," as it is called, for snake-bites, and which has dignified very poor whiskey with the title of "antidote." Experience has proved that whiskey has no special virtue as an antidote, but that alcohol in some form is indispensable in the treatment of snake-bite. You cannot administer it too soon, either, but should commence at once, giving frequent and full doses of brandy, rum, whiskey, or gin, until signs of intoxication appear; but you need not expect to see these signs very soon, for the general depression that follows a snake-bite is so great that the patient will bear an immense amount of alcohol without becoming inebriated. The administration of the spirit should accompany, but not be substituted for, the ligature and other measures advised, for men have died from snake-bite while in a state of profound intoxication, while many cases of recovery are recorded where the knife and ligature, one or both, have been used along with free stimulation. If within reach, it is a good plan to give ammonia (one-half to one teaspoonful of the spirit) with the whiskey, on account of its stimulating properties. When the patient is too weak or too sick to swallow the liquor, it may be given as an injection, warmed by the addition of a little hot water; and at the same time he may inhale hot alcohol, or even ether, to assist in reviving his vital forces.

A recent case is recorded where the patient made a good recovery under the use of large doses of the iodide of potassium, con-

joined with the liberal administration of alcohol ; but if the intermittent ligature is used with or without cutting or cauterizing the wound, the alcohol alone will be found efficacious, without the addition of any drug whatsoever. This free stimulation, or what one writer terms "this gentle inebriety," should be kept up for some time, or until reaction is fully established and the patient obviously out of danger. The after-treatment of the wound and the surrounding swelling should consist of the application of cloths saturated in warm water, medicated with laudanum and acetate of lead, or, in case of excessive inflammation, the emollient poultice frequently renewed. When the immediate effects of the poison have passed off, quinine and stimulants, with a very generous diet, will be necessary to restore the strength of the patient.*

Bites of Domestic Animals.

Bites of domestic animals are not uncommon, and occur in the following rate of frequency : First, bites of *dogs*, which some-

* [FAYRER, in his elaborate work on the Poisonous Serpents of India (of which the *Daboia* and *Cobra* are considered to be extremely venomous), gives the following summary of the treatment of snake-bites, so far as it is likely to be of any value :—" Apply, at once, a ligature, or ligatures, at intervals of a few inches, as tight as you can possibly tie them ; and tighten the one nearest to the wound by twisting it with a stick or other such agent. (In another part of the same chapter he emphasizes the necessity for tightening the ligature to its utmost limit, without any regard whatever to the pain it may cause, for unless the flow of blood is completely arrested, the procedure may utterly fail.) Scarify the wound and let it bleed freely. Apply either a hot iron or live-coal, or explode some gunpowder on the part ; or apply either carbolic or some mineral acid, or caustic. Let the patient suck the wound whilst you are getting the cautery ready, or if any one else will run the risk let him do it. If the bite be on a toe or finger, especially if the snake has been recognized as a deadly one, either completely excise, or immediately amputate at the next joint. If the bite be on another part, where a ligature cannot be applied, or indeed, if it be on the limbs above the toes or fingers, cut the part out at once completely.

" Let the patient be quiet. Do not fatigue him by exertion. When, or even before symptoms of poisoning make their appearance, give eau-de luce, or liquor ammoniæ, or carbonate of ammonia, or even better than these, hot spirits and water. There is no occasion to intoxicate the person, but give it freely and at frequent intervals.

"If he becomes low, apply sinapisms and hot bottles, galvanism or electro-magnetism over the heart and diaphragm. Cold douches may also be useful.

" The antidotes, in addition, may be used by those who have faith in them ; but, as I have said, I fear there is no reason to believe that they are of any use. Encourage and cheer the patient as much as possible. As to local effects, if there be great pain, anodynes may be applied or administered, and antiseptic poultices to remove sloughs ; collections of matter must be opened.

" Other symptoms are to be treated on general surgical principles.

" This, I believe, is the sum and substance of what we can do in snake-bite. If the person be not thoroughly poisoned, we may help him to recover. If he be badly bitten by one of the more deadly snakes, we can do no more."—ED.]

times cause poisoned wounds, although the animal may not have hydrophobia ; next, bites of *cats* and *hogs*, and, more rarely, of *horses*. The bites of the first three create both contused and lacerated wounds, owing to the existence of long fangs or canine teeth in these animals, while the bite of the horse usually results in a bruise or simple contusion. There are exceptions to this, however, for occasionally a vicious horse will tear and mutilate the flesh fearfully, returning again and again to the attack.

The universal dread of hydrophobia causes the bite of the *dog* to be more feared than any other accident that can happen to man, and the most prompt and active treatment is demanded by the bitten party. Bites inflicted by dogs while engaged in play, or while fighting with each other, are usually harmless and heal by granulations, with but little local inflammation or constitutional disturbance ; but as the excitement under which the animal labors at such times may cause a change in the character of the saliva, with which a dog's mouth is so abundantly supplied, it is always well to treat it from the first as a poisoned wound.

The bite of the common *cat* is usually followed by considerable local inflammation, but, unless laboring under hydrophobia, the wounds inflicted by this animal generally yield to very simple treatment.

Although bites of *swine* occur very rarely, still every country physician in his lifetime is usually called upon one or more times to dress the fearful wounds made by infuriated hogs, and no physician ever treated one such case without uttering a fervent prayer that he never might see another. The writer is informed by one who professes to know whereof he speaks, that a pig never attacks a human being ; it is invariably the old sow, with tusks fully developed, enraged by an attempt to deprive her of her nurslings ; or the old male interfered with in some way, that makes its fearful assaults upon man. The *Peccary*, or wild hog of this continent, which is probably the progenitor of the domesticated animal, although weighing but sixty or seventy pounds at most, will attack anything moving near it. It has tusks so sharp that whatever it attacks is cut as with a knife, and knowing no fear, it will rush at men mounted or on foot, cutting the legs of man and horse, until the former is in danger from loss of blood, while the latter is frequently "hamstrung" and ruined. In the Northwest, where mast abounds, large herds of swine go at large and forage for themselves, the owners driving in the young animals in the autumn, but allowing the breeders to return to their feeding-grounds. These, in time, become exceedingly savage and dangerous, and, as they are very swift of foot, they are much dreaded by settlers who

occasionally encounter them. Domesticated swine in their old age are sometimes very savage. The writer well remembers the case of a young farmer in Grafton County, New Hampshire, who, in attempting to drive an old hog from one enclosure to another, was attacked and actually pinned to the ground by the animal, the inside of one thigh, his groin and abdomen being fearfully lacerated. The unfortunate man died after a few days of intense suffering. The writer has been thus prolix in treating of wounds inflicted by swine, for the reason that the subject has not been mentioned in works of a similar character heretofore, and the danger arising from this source and from tardy or inefficient treatment are too little understood and appreciated.

The bites of most of our small untamed animals come within the same category as those heretofore mentioned. Every country school-boy has been bitten more than once, either by the *rat* he was attempting to "bell," or by the *squirrel* he was trying to tame, and such wounds are generally forgotten with the "feeling better" which proverbially ensues when it has "done aching." Recently, however, attention has been called to the dangerous symptoms resulting from the bite of the common *American skunk*. It is stated upon good authority, that not only are such wounds very dangerous in themselves, but that they are more frequently followed by hydrophobia than are the bites of dogs.

The bite of the *fox* is known to have been followed by hydrophobia; and as a mad fox is perfectly fearless in its attack upon man, such accidents must be liable to occur in sections where this animal abounds. A country physician informed the writer that many years ago he was driving through a bit of forest, when a mad fox ran out and attempted to bite the horse. Fortunately, the rapidity with which the doctor drove prevented the animal from doing any injury, until an opportune flock of sheep attracted the attention and attacks of the fox. A large number of animals, mostly horses and dogs, were bitten by this fox, and several of them had hydrophobia, if the evidence is at all reliable. As is usually the case, many of the bitten animals were killed at once.

Unfortunately for science, and for the peace of mind of individuals who have been bitten by dogs, the animal is usually dispatched immediately, instead of being confined in a secure place until the fact of its being hydrophobic is settled one way or the other. The terrible certainty could not be worse to the victim than the dreadful and long-continued depression that accompanies a doubt, and the percentage of cases where the bites are harmless is so great, "that the greatest good of the greatest number" demands that the attacking animal shall in all cases be kept until all

doubts are solved. The advice of the witty Charles Lamb was about as sensible as the course usually pursued. He left a pet dog with a friend while he went a journey. From his first stopping-place he wrote to this friend some minute directions concerning the care of his dog, and wound up by saying, "If the dog runs mad and bites your children, have them shot at once, but tie the dog up to see if he really was mad." *

TRANSPORTATION OF SICK AND INJURED PERSONS.

As most accidents occur to persons when at a greater or less distance from home, it is important to devise some mode of carriage that shall be comparatively easy and at the same time prevent further injury to the wounded limb or trunk. This can be accomplished in various ways, dependent upon the location and nature of the wound. If about the head, arms, or chest, a very

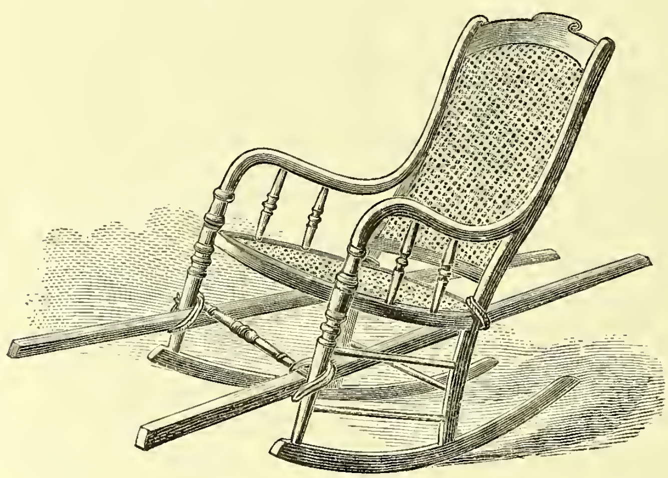


FIGURE 246.—Arrangement of a rocking-chair so as to adapt it for carrying a sick or injured person.

simple method consists in taking two strong sticks—a little longer than a common broomstick—and passing them under the seat of a chair, one at each side, and then securing them in place by tying them to the legs of the chair. The patient can then be seated in the chair while two men, placing themselves between the project-

* [For an account of Rabies and Hydrophobia, see the Chapter on Acute Infectious Diseases, in Vol. II.]

ing ends of the sticks, as in the old-fashioned sedan-chair, or the Chinese palanquin, can carry a heavy person with great ease for a considerable distance. If the sick or injured person is not able to carry his head erect, a common rocking-chair can be used, but in this case the ends of the sticks which project through the front of the chair should be fastened by strong strings to the lower round, thus giving the chair an inclination backward and enabling the patient to rest his head comfortably. It will be readily understood that the sticks should rest against the bottom of the chair behind, and then be carried forward under the first or second round, according to the inclination required, and fastened there securely. If an ordinary chair is used instead of a rocking-chair, the head of the patient can easily be supported against the breast of the rear bearer. If a common settee can be procured, an injured person can be comfortably transported by four bearers in the manner illustrated below. In the absence of a settee, an ordinary cheap pine sofa can be used, such as is found in most dwelling-houses. In this case, however, if the distance to be accomplished is very great, two sticks or bits of scantling should be passed under the sofa, one under each end at right angles to its length, when it may be carried by four persons, each using one hand, instead of lifting it to the shoulder as in the above cut. If the number of bearers is limited, the sofa may be carried by two persons if poles or two long strips of stout board be passed under the sofa lengthways and secured at each side, as in the case of the chair.

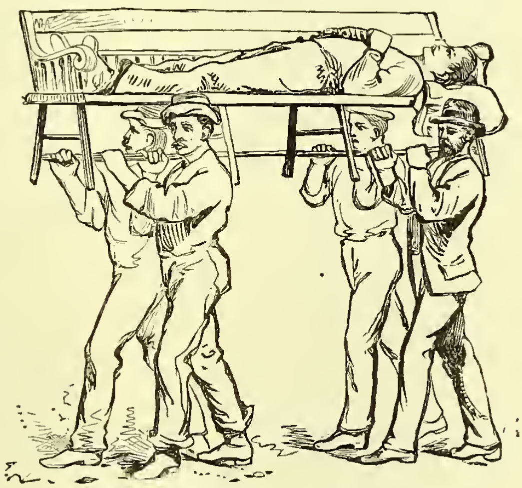


FIGURE 247.—A settee used as a stretcher.

If accident or sudden illness occurs to a person in the woods or anywhere away from the habitations of men, a very good stretcher may be improvised with four sticks, a blanket—either rubber or woollen—and a little stout string or whipcord. The accompanying illustration gives a better idea of it than any verbal description. If a darning- or sail-needle and twine can be procured, it is well to sew the corners of the blanket after they have been turned over the angles formed by the crossed sticks ; but if no needle is at hand,

a knot may be tied in each corner of the blanket, then turn each corner over the angle, as below, and secure the whole in place by winding a string *back* of the knot and tying it securely.

I have seen a very useful stretcher made at short notice by laying a strong sheet upon the ground and rolling each side over a convenient pole—a couple of rake-handles will do very well. Continue to roll tightly and evenly upon each side until the poles are about eighteen inches apart. The sheet may be secured with

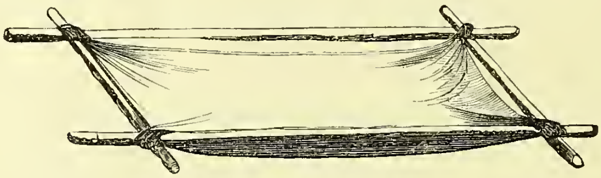


FIGURE 248.—A stretcher made with a blanket and poles.

tacks, if any are available ; but if not, the bearers must grasp the rolled sheet at each side and hold it firmly, when there will be little danger of its unwinding or giving way. It may be proper to remark here that this is a very convenient manner of moving a sick person from one bed to another, or to a sofa while the bed is is being made up.

The last three descriptions of modes of carriage are intended to apply to persons seriously ill, or to those who are wounded about the lower part of the body and legs, while *all* heretofore said presupposes the possibility of securing the materials for the construction of chairs, stretchers, etc. A large number of cases, however, occur when and where an immediate removal is necessary, and no means are at hand for the construction of any apparatus. One person in good health and of average weight can carry another of equal size, if he husbands his resources and lays out his strength to the best advantage. This can be done as follows : place yourself at the right side of the patient and instruct him to place his right arm around your neck, turning slightly toward you. Then pass your left arm around his back under the arms, and your right arm under the bend of his knees, pushing your arms as far as possible and drawing him closely to you so as to bring the weight both of his body and legs in the bends of your elbows. You are then in a position to put out your strength without waste, and you will be surprised to see how easily you can carry a person quite a distance, or even up one or two flights of stairs. It renders the labor much easier if the person carried is raised so high that the upper part of the body leans over the left shoulder of the bearer.

Two persons of ordinary strength can carry a sick or wounded man very easily in either of the two modes described and illustrated below. By the first method two men standing side by side take a firm hold of each other by the *inside* shoulders, while the hands which are *outside* are closely grasped by interlacing the fingers. The interlocked hands are then passed behind the patient into the angle of the legs under the knees while his shoulders rest against the inner arms. The patient, if conscious or not too severely injured, may aid his bearers by passing his arms around their necks.

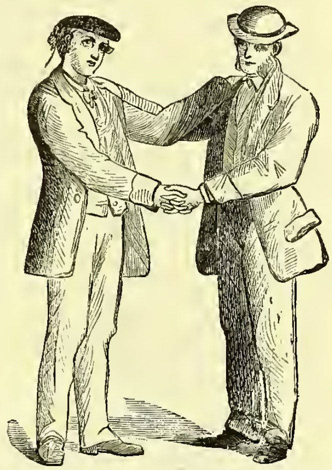


FIGURE 249.—Mode of joining hands and arms to carry an injured or sick person.

Another, and perhaps better method of carriage by two men, is the "Queen's Chair," as it is called and used by children in their May-day festivals. Two persons facing each other seize their right wrists with their own left hands, and then each takes the left wrist of his fellow with his right hand, grasping it firmly. The interlocked hands form the chair upon which the patient sits while his arms are thrown over the shoulders of his bearers. The cut below simply shows the *manner* in which

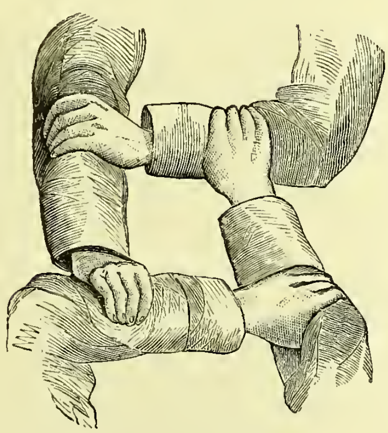


FIGURE 250.—A "queen's chair."

FIGURE 251.—Patient borne in a "queen's chair."

the hands are placed, but the arms are seized too high up and the proper purchase is lost. The fingers should be clasped about the wrist itself at its smallest part.

The second figure simply shows the chair occupied, and helps illustrate this mode of transportation.

The first mode described in this article, viz., the common chair, with handles attached, and the two last, which may be called the "human chair," are especially useful in carrying a patient who has received a fracture of the ribs. The victim of such an accident should not be laid upon his back, even if he does not complain of an increase of pain, for the broken end of the rib may, by this change of position, be thrust into the lung, and cause a very serious complication. If the arm or shoulder be injured, or the collar-bone broken, and the patient be unable to walk for other reasons, the arm should be supported in a sling before any attempt is made to remove him. This is very readily made by tying a couple of handkerchiefs together, or by using a scarf; even a shirt or pair of drawers will answer in an emergency. The sling must be supported upon the shoulder of the sound side, and arranged so as to place the arm at the angle which will give the victim the greatest comfort. The accompanying cut gives a general idea of a sling, but it can be modified to suit each case, carried back over the elbow, or forward over the hand, and raised or lowered as circumstances indicate.

FIGURE 252.—Arrangement of a sling for an injured arm or shoulder.

If the leg or thigh is fractured or dislocated, the patient should be prepared for transportation by making the limb as immovable as possible. This may be effected by placing strips of wood or bark at each side of the injured limb, and securing them in place by tying them with ribands of cloth torn from a handkerchief or from the underclothing, and carried around the leg enclosing the strips. The legs may then be laid as near together as possible, and broader strips of cloth tied around both in several places, thus fastening them together and making the sound limb act as a temporary splint for the injured one. No pressure should be made at the point of injury, nor indeed anywhere that may cause the slightest displacement of any broken bone. The strips of wood or bark should extend the whole length of the leg, and should be as wide as the leg at the ankle. Shorter strips may be placed over and under the injured limb, and secured as described above. Remember that the limb must be protected from all motion, and yet no painful pressure be made upon the wound itself. This subject will be treated of still further under the head of Fractures.

FRACTURES.

General Considerations.

Many accidents involve the breaking, or, as it is called, the *fracture* of bone. The composition of bone varies slightly at different periods of life and in disease. The larger the proportion of mineral or hard to organic (animal or soft) matter, the greater their brittleness. In childhood they contain proportionately more of animal matter, hence the bones of children bend easily and break seldom. In old age the mineral matter is in excess, and hence old people are very liable to fracture. In the disease called *rickets*, the bones are weak, yielding, and easily broken. Fractures are most frequent between the ages of twenty-five and sixty years. A bone may be broken in three ways:

FIGURE 253. — A green-stick fracture of bone.

1st. By direct violence, the force being applied directly at the point of fracture, as a blow on the head, from a fall, or the passage of a wagon-wheel over a limb.

2d. By indirect violence, the force applied at one part of the body breaking a bone in another part, as a fall on the hands, which breaks the collar-bone, or one on the feet which breaks the thigh. A fall upon the top of the head, or upon the forehead frequently fractures not the top, but the base of the skull. In both direct and indirect fracture there is usually a bruising or "*contusion*" of the soft parts, but in the latter case it is more or less removed from the point of fracture.

3d. Bones may be broken by muscular action, as when the knee-pan is broken in two by violent efforts in jumping, or the arm, in throwing. The fracture thus produced may be either complete or incomplete. In *incomplete* fracture the bone may be cracked or splintered lengthwise, or bent and broken half way through. The latter form is called *green-stick* fracture, because it is precisely what is produced in the attempt to break a green stick. It commonly occurs in children. The young bone, like the young wood, is comparatively soft and pliable, and partly breaks and partly yields.

A *complete* fracture extends entirely through the bone. The break may be *transverse* or *oblique*, or *crushed* or *impacted*. In the crushed or *comminuted* form, as it is termed, the bone at the point of fracture is broken into fragments. In the impacted frac-

ture, the same force that breaks the bone drives one piece into the other, in other words *telescopes* it and fixes it firmly.

The most important classification of fractures is that which divides them into *simple* and *compound*. A *simple* fracture is one in which there is no open wound communicating with the fracture. A compound fracture is one in which there is such a wound produced either by the same hard body that made the fracture, or by the ends of the broken bone forcing their way outward. A fracture, either simple or compound, is said to be *complicated*, when there is with it serious injury to other parts than the bone: as for instance, when it opens into a joint, or ruptures a large artery, or lacerates or severs important nerves, or injures internal organs. To sum up, in tabular form, the classification of fractures, we have

FRACTURES

Simple.	Compound.

Either of these classes may be:

Complete,	Incomplete.
Transverse,	Cracked.
Oblique,	Splintered.
Comminuted,	Bent.
Impacted.	

Either of the above may be

Uncomplicated or Complicated.

Diagnosis, or, *How to detect a fracture.*—In examining a case of suspected fracture, it is necessary to ascertain, first. whether fracture has really taken place, and second, what the exact location and character of the fracture is. The signs of fracture are: 1st. *Pain*; 2d, *swelling*; 3d, *loss of power* in the limb; 4th, *change in the outline* of the part; 5th, *unnatural motion* in the part; 6th, *a grating sound*, called *crepitus*, heard between the broken ends of the bone on moving them. The first four mentioned may exist without fracture, and in fact may prove that a bone is dislocated. The last two, however, are certain proofs that it is broken. After uncovering the injured portion of the body, and also its fellow of the opposite side, we observe and compare their outlines and position.

An accurate understanding of the natural contour, as seen in the uninjured side, is of the utmost importance in determining the character of the injury. The bones and joints of a person are never exactly alike, and we may mistake a natural prominence

for a dislocation or fracture, hence never fail to make a thorough comparison of the two limbs. After inspection we may take measurements with a tape; starting from some bony prominence near the injury, and comparing the two sides, determine whether there is shortening or displacement sidewise. Then, grasping the part above and below the injury, we may determine whether there is *unnatural* movement, and, by close attention, we may hear or feel the grating of the rough broken ends upon each other.

To determine the character of the fracture, we wish to know the kind of force that produced it, whether direct or indirect, and the direction in which the force was applied. The fractures produced by direct violence are generally more serious than those which result from indirect force. The majority of the fractures in the long bones are oblique. The change in the outline of the limb or part is the most important indication of the character of the fracture and its location. This change in outline may be the direct result of the violence, as when a rib is broken and driven in, or it may be the result of muscular action on the two fragments of bone, as the muscles being irritated by the injury and pressure upon their nerves, contract spasmodically. This may draw one fragment out at an angle with the other; it may twist one of the fragments around in its own axis, or it may cause one fragment to ride over the other, shortening the limb. To understand the position of the bones, it is important to know where the muscles which lie about the part are attached, and in what direction they draw. For example, if the arm is broken below the insertion of the deltoid or "*epaulet*" muscle, so called, because it occupies the point of the shoulder, the upper fragment will be drawn *outward* by its action, because the strong tendon or cord which forms the lower end of this muscle is attached to the arm-bone, midway between the elbow and the shoulder. Meanwhile the lower fragment will be drawn *forward* by the anterior brachial muscle, which commences about where the deltoid ends, and which is attached to a projection upon the upper end of the forearm, just below the elbow, called the "coronoid process." (See **Fracture of the Humerus.**)

Differential Diagnosis, or, *How to avoid mistakes.*—A fracture may be mistaken for a severe bruise, for a sprain and for a dislocation. If the patient is not seen until some hours after the accident, the swelling and inflammation may be so great that a satisfactory examination is impossible. In that case we must wait until this condition has passed away, using hot or cold water applications in the meantime to hasten its progress. In a simple *bruise* we find pain and swelling, and at times loss of power in the limb, with slight change in its outline. But there will be no unnatural mo-

tion below the point of injury, and no grating sound as between two ends of broken bone. *A sprain* will also lack these last signs. In a *dislocation* we find unnatural *fixedness* of the limb. Its motion is restrained. In *fracture,* on the contrary, we have unnatural movement of the limb, that is—we can move it not only in the natural direction, but also in other and unnatural directions. Of course the liability to mistake a fracture for a dislocation occurs only when the injury is near a joint. Moreover, if it is a dislocation, when we succeed in bringing the bones into place they will remain, while if it is a fracture they will slip back at once when we release the limb. The difficulty of recognizing a fracture is increased when there are two bones side by side, as in the forearm or leg, and only one of them is broken. Careful examination will, however, generally detect the true condition.

Prognosis, or, *The probable progress and result.*—Simple fractures, in which there are no open wounds, and no serious injuries to other parts than the bone, are seldom fatal. At Guy's Hospital, London, during a period of six years, 469 cases of such fracture of the thigh were recorded, of which 17 were fatal ; 888 cases below the knee, of which 8 were fatal. When there is an open wound at the point of fracture the danger is much greater. But such fractures are less serious in the arm than in the leg, and when occurring above the knee are more serious than when below. At Guy's Hospital during six years, of 94 cases of such fractures of the arm, 16 died. Of 202 cases of such fracture below the knee, 56 died. Of 52 cases of such fractures above the knee, 19 died. To recapitulate : in Guy's Hospital, during a period of six years, there were treated

SIMPLE FRACTURES.

Place of Fracture.	No. of Cases.	Deaths.	Per cent.
Leg, below the knee	888	8	1.0
" above "	469	17	3.5

COMPOUND FRACTURES.

Place of Fracture.	No. of Cases.	Deaths.	Per cent.
Arm	94	16	17.0
Leg, below knee	202	56	27.7
" above "	52	19	36.5

This table gives some idea of the risks of these accidents, though the enfeebled and often diseased condition of many of the patients received in a hospital makes the number of fatal cases greater than in private practice. Aside from the risk to life the dangers are :

1st. That the *bones will not unite.* This is a rare occurrence. Hamilton says probably not more than once in five hundred cases.

When it does happen, or a so-called *false joint* is formed, the bones are either not united at all and easily movable on each other, or they are united more or less firmly by cartilage or ligaments. Sometimes the false joint very closely resembles a true joint.

2d. That a *deformity* will remain, the bones not being properly set, or, after setting, not being kept in place by the dressing, so that enlargement and irregularity of outline will be permanent.

3d. That the bones will unite at an angle, making a crooked limb.

4th. That there will be shortening as a result of destruction of some portion of the bone, or of the overlapping of the fragments. This latter accident is very common. In fractures of the leg above the knee it is a constant result. The shortening varies from one fourth of an inch to one and a half or two inches. When we remember that the legs of a sound and healthy person differ as much as a half inch on the average, we need not fear that the slight shortening which follows a well-set fracture will cause any noticeable deformity.

5th. When the fracture is in the vicinity of a joint it is frequently followed by stiffness of the limb, even though it may not have opened into it. This is sometimes the case in fractures remote from a joint when the limb has been long confined in splints.

6th. In complicated fractures, which involve injuries to other parts near the seat of fracture, the result will depend on the extent and character of these injuries.

Treatment.—It is not well to attempt a thorough examination or a replacement of the bone until the patient has been taken home, or placed on the bed where he is to remain. He is to be carried thither in that way which will shake and disturb the broken member least. For the best mode of transporting a person who has met with a fracture, the reader is referred to the Section upon The Transportation of Sick and Injured Persons, on page 630. Careful transportation at the outset may prevent much irritation, or even the changing of a simple fracture to a compound one by the sharp end of a broken bone crowding through the skin. If there is an open wound and much bleeding, pressure must be applied over the artery above the wound until it can be tied. This may be done with the thumb or by placing a folded pad of cotton cloth directly over the artery and binding it down with a bandage, or we may tie a handkerchief about the limb above the wound, and then, slipping a short stick under it, twist the stick until the handkerchief binds tightly enough to stop the flow of blood. For more complete directions consult the section upon **Bleeding** (page 590).

The bed on which the patient is to lie should not be a soft, but a hard one. A hard mattress is best, and the sheet should be smoothly stretched upon it. When the patient is comfortably placed there, we may proceed with the examination by the methods already indicated, and having ascertained the existence of fracture and its character, we endeavor : 1st. To restore the bones to their natural position. 2d. To keep them there. The only cases in which a delay is necessary at this point, are those in which the patient is not seen until some time after the accident and the inflammation and swelling are very great. In these cases we must wait until, with the use of heat and cold, or poultices, the inflammation and swelling have subsided, keeping the limb in position in the meantime, by pillows or sticks of wood enveloped in cloth, or blankets or clothing rolled up firmly and placed closely upon each side of it while it rests upon a pillow. It is better, if possible, to proceed to set the bone at once.

We meet with two kinds of difficulty in our endeavors to set a bone. 1st. Splinters or fragments of bone, or portions of flesh getting in the way and preventing the return of the parts to their places. This difficulty is to be met by patient and gentle movements, working the bones together, and if we cannot fully succeed without too much handling, we must do the best we can, and trust that Nature will do the rest.

2d. The chief obstacle, and one always more or less present, is the drawing or *contraction*, as it is called, of the muscles. Those which lie about the seat of the injury are irritated by the blow, or by the sharp ends of broken bone, and contract, either separating the fractured extremities of the bone sideways, or drawing one up at an angle with the other, or causing them to ride over each other, thus shortening the limb. We meet this difficulty by putting the limb in that position which would naturally relax the muscles. For example, if the leg is broken above the knee, we turn it on its outer side and bend the knee and hip-joints ; this allows the muscles to relax and lie loose. Sometimes the muscular contraction is so great, and the parts are so sensitive, that it is desirable to use ether in accordance with the suggestions on page 708. Having thus put the limb in the most favorable condition, we quietly but firmly draw down the lower fragment, while an assistant holds fast the limb above the fracture. These two movements are called *extension* and *counter-extension.* Sometimes the bones will immediately fit themselves together, and sometimes much careful manipulation is required.

When the bone is properly set, the natural outline of the limb should be restored, like the sound limb, and the length of the

two should be the same. It should be remembered, however, that the limbs of very few persons are *exactly* of the same length, and this is especially true of the legs, as hundreds of measurements have proved that they are rarely *precisely* alike. The difference usually is very slight; but cases might occur in which this fact would cause doubt and anxiety to the operator. In most cases the patient himself can give the necessary information, but in all cases of fracture the limb should be carefully measured when set, and very frequently afterward while under treatment. The measurement should be made with some inelastic cord or tape, and never with a strip of cotton or other cloth, as it is liable to stretch and deceive the operator. The most convenient points are the centre of the navel, and the outside of the middle of the knee-pan, or the upper edges of the ankle bones. One end of the tape should be held firmly upon the navel, while the other end should be carried to the points above mentioned, applying first to one knee-pan or ankle, and then the other. In this way any real difference in length can be detected and remedied if possible.

The bones being replaced, we next provide means to keep them in place, otherwise the weight of the limb, the action of the muscles, or the movements of the patient might easily displace them again. For this purpose we use bandages, splints, extension, and apparatus of various kinds, designed to support or suspend the limb in proper position.

Bandages.

The roller bandage is made of flannel, cotton, or linen cloth, from half an inch to four inches in width, and from one to nine yards in length, according to the place for which it is designed. It should be prepared for use by being tightly rolled. In putting it on, be careful that it is not so tight as to interfere with the circulation of the blood; that it is perfectly smooth; that every part of the skin is covered, and that the pressure is even. If the bandage is too tight, it will be painful, and the limb below will turn dark. In bandaging the extremities, the ends of the toes and fingers should be left uncovered, so that we may observe their color and temperature. [See, also, Chapter on Nursing, in Vol. II.]

Dressings for Fractures.

For broken bones in the head or trunk, bandages, aided by adhesive plaster will suffice. But when one of the bones of the arm

or leg is broken, we need, in addition to bandages, one or more strips of some stiff material to keep the bones in position and clamp them together. These are called *splints*, and are made of various substances, as wood, tin, zinc, leather, pasteboard, gutta-percha, or wire-cloth. The immovable dressing is a kind of splint made by soaking bandages in a mixture of plaster-of-Paris, or with a solution of glue, starch, water-glass, or other preparations which harden after having been put on the limb, and make a firm casing and support.

Wooden splints may be made readily, when needed, of shingles or clapboards, or the bark of a young tree. One or more strips should be placed on the sides of the limb after being padded to make them fit, and they should be bound on with roller bandages. Sheet tin or zinc may be readily fitted to the limb, pierced with air-holes, and bandaged on. To fit a sole-leather or pasteboard splint, cut first a pattern in paper, then cut the splint, soak it in hot water until it can be moulded accurately to the limb, bind it on with the roller bandage, and let it remain until quite dry, then take it off, and trim the edges if at any place it overlaps; and to remove roughness, line it with cotton sheeting, and it is ready for use. For a starch or glue dressing, having first padded the limb with cotton batting, so as to smooth off any bony prominences and fill up depressions, wind a roller bandage over it from below upward. Then take boiled starch and melted glue in equal parts, thoroughly mix them by stirring together while hot, and brush them lightly over the bandage, covering all parts of the layer of bandage with an even coat. Cover this with a second layer of bandage, and repeat the starch and glue, and so on, until four or five layers of bandage have been put on, and each has been painted, except the outer one.

This splint will dry in twenty-four hours or less, and can then be split up and sprung open so that it can be taken off when desirable. It is a good plan, when it is taken off, to straighten and smooth the edges, and bind or strengthen them with strips of good adhesive plaster doubled, so as to enclose these edges; then pierce each side with eyelet-holes, that they may be readily laced together. Either starch or glue may be used alone, but the starch dressing will not always be sufficiently elastic to be opened and taken off, and does not retain its shape and stiffness as long as the mixture of the two.

Plaster-of-Paris Dressings.

The most convenient material for an immovable dressing is perfectly dry plaster-of-Paris, or calcined plaster which has not been exposed to the air and allowed to absorb moisture previous to its use. The bandages to be used with this should be of some coarsely woven material like cheese-cloth, "crinoline," or mosquito-netting, or better still, the cheapest, loosely woven cotton cloth, or "muslin," as it is often called. Moreover, they should not be too wide, two and a half or three inches being better than a greater width, as they can be applied more smoothly. The most convenient length is two and a half or three yards, as rollers made too large do not dampen readily when put into water previous to use. Great care in the making of these plastered bandages will add much to the success of the splint. They should be covered with the dry plaster, *well rubbed in* so that the meshes or spaces between the threads of the cloth shall be evenly *filled*, and that too, upon both sides, and then closely but not *too* tightly rolled. When applied they should be soaked in water for two or three minutes until simply wet through, and the best way is to put only three or four rollers into the water at first, and then let an assistant add a dry one when you take out one to use, so as to avoid soaking too long, as even in the water they will grow hard and the dressing will crumble if that takes place. In applying them where there is no swelling and none expected, as in an old sprain or weak joint, the limb may be simply covered with a common roller-bandage, and the plastered bandage be placed over that; but generally, in applying any immovable dressing, whether of this variety or of starch or glue—as they shrink a little, and also to provide against swelling—the limb should be encased evenly in a layer of cotton batting, or two layers of tailor's wadding, held in place by coarse stitches, before the dressing is applied. The moistened plastered roller should be applied smoothly and with turns, when necessary, so that its pressure when dry shall be even throughout, and a little plaster and water as thick as honey may be spread over these turns, and over the whole when we get through with the rollers. This will give a smooth surface to a very firm dressing. Three or four thicknesses of bandage are sufficient, as unnecessary weight lessens the value of the appliance.

In fractures near a joint, this, as well as all other splints, should take in that joint so as to secure perfect rest.

For the success of a plaster dressing it is important that the plaster be of the best quality. If it has been imperfectly calcined,

or long exposed to air and moisture, it will not harden well, and shipmasters or those who may be called upon to use this material, should provide themselves with a supply of the best quality, secured in air-tight tin cases. (See also, **Fractures of the Leg.**)

Extension.

Sometimes the tendency in the limb to draw up and shorten is so great that it is necessary to use some contrivance to keep a constant pull upon the loose fragments. This may be accomplished by a weight at the end of a cord which is attached to the limb by means of adhesive plaster, and runs through a pulley in the foot of the bed. A broad bandage may be passed between the thighs and attached to the head-board to pull against the weight, or the foot of the bed may be raised so that the weight of the body will serve this purpose. (See Gurdon Buck's Apparatus, in the Section on **Fractures of the Thigh-Bone.**)

Special Apparatus.

Many kinds of special apparatus have been devised: beds specially suited to fractures; boxes, inclined planes, and cradles for suspending the limb. The simplest device that will support the limb in the required position is the best.

Treatment of Compound Fracture.

In compound fracture, we have to treat a fracture and a wound. In treating the fracture we must avoid irritating or covering the wound, as in the latter case the danger from the absorption of matter would be greater to the patient than the benefit in supporting the fragments of bone, if the open wound is of considerable size. In all cases we must *aid* the discharges, treating the wound in accordance with the directions for treatment of other open wounds, in another part of this chapter. If the bone is crushed, and there are loose splinters or fragments, they should be removed at once. Before treating the fracture, the question whether amputation is necessary must of course be settled, and in all these cases the services of a surgeon become absolutely indispensable.

After-Treatment.—It may be necessary to give the patient a dose (20 to 30 drops for an adult) of laudanum, paregoric (two to three teaspoonfuls), or morphine (one-eighth of a grain) after the operation of setting the limb, if he is uneasy or in pain. If, how-

ever, the pain in the limb increases and becomes very severe, and especially if there is any discoloration below the dressing, *it should at once be removed*, and put on again, since this shows that the limb has probably swollen under the bandages, and gangrene or mortification may result, unless the pressure is taken off.

If the patient has any fever, his diet should be light for a few days, and his bowels should be kept open with Rochelle salt. After ten or twelve days, it is desirable that the joints next to the fracture should be moved occasionally, lest they become stiff. Avoid bed-sores by keeping the sheet smooth under him, and rubbing the back two or three times daily with alcohol or some kind of liquor.

In fractures of the upper part of the body, the dressings should be kept on from four to six weeks; in those of the lower part, from five to eight weeks.

Complicating Diseases.

In addition to the dangers already spoken of, as occurring during the treatment of fracture, are the two terrible conditions of erysipelas and pus-poisoning—which cannot be too closely guarded against—and must be combated, when occurring, by every means at our disposal. In every case we must secure perfect cleanliness and thorough disinfection. *Pus-poisoning*, or *pyœmia*, as it is called, is the result of excessive maturation of a wound: the pus or matter which forms therein during the healing process, being absorbed or soaked up by the raw surfaces, finds its way into the blood, causing a slow but dangerous poisoning. The action of this poison is much more rapid if it arises from a wound of one of the internal organs. If this poisoning takes place, the matter or pus in the wound changes from a creamy color and consistency to a thin bloody or tea-colored fluid, while the skin about the wound assumes a dark purple or bluish hue, the wound itself gapes open, and the healing process abruptly ceases. The heat of the body increases, the pulse becomes small, quick, and sometimes irregular. The patient may become delirious, or may lie in a half-stupor. Severe chills may occur, followed by profuse sweating and great depression of the powers of life. There may be severe pains in different parts of the body, with or without profuse diarrhœa, or the diarrhœa may exist without the pain. Rheumatic pains may occur at or near a joint, which will indicate blood-poisoning from an abscess about the joint or bone. The breathing may be rapid and difficult, with a dry cough, while the breath is said to have the odor of new-mown hay.

Any of these phenomena occurring during the treatment of a wound should excite suspicion at once, and lead to the adoption of the most energetic means of cure. The room should be well ventilated and kept at an even temperature—neither too hot nor too cold (about 70° Fahr.). Disinfectants should be freely used by sprinkling, or evaporated from open dishes. [Carbolic acid dissolved in water, in the proportion of an ounce of the acid to a quart of the water.] Cotton cloths saturated in the disinfectant, and hung up about the room, answer an admirable purpose, and all rags, etc., applied to the maturating wound should be soaked in the same. The best deodorizers and disinfectants are carbolic acid, liquor of the chloride of soda, permanganate of potash, all much diluted. [More explicit directions relating to Disinfection will be found in Volume II.]

If possible, a stream of warm water, also impregnated with the disinfectant, should flow upon the wound at frequent intervals, or a syringe may be used, but not too forcibly. The discharges from the body should be received in vessels partly filled with the fluid disinfectant, or with chloride of lime. Sponges should not be used for washing the wound, but cotton, wool, or rags, which should be burned after using once.

Feed the patient well and often with the most nutritious food available. This is of the utmost importance, as plenty of new and healthy blood is needed in this condition of the system. Broths, meat-juice, rice and milk, or cream, form the best diet, and should be given in small quantities, but very often. Dr. Fordyce Barker's "Fever Food" is admirably adapted to these cases, viz.: Into a pint of sweet milk (unskimmed) put the whites of four fresh eggs. Put the whole into a bottle or jug, and shake it well for several minutes, the longer the better. Strain into a dish, and meanwhile wash the bottle. Pour it back into the bottle and set it in a cool place, in a refrigerator, or upon ice, if possible. Give the patient form two to four tablespoonfuls every one to three hours, or, if the stomach will retain it, give a wineglassful every three hours.

The medicines needed are few, and consist of iron in some form, the old "tincture of the chloride" (in doses, for an adult, of 15 drops in water) is the best, and quinine, in doses of two to three grains. These should be repeated every two or three hours at least. Spirit of some kind must be given, if the patient is accustomed to its use, but if not it should be dealt out sparingly. Great prostration and a tendency to fainting justifies its use to the extent of relieving these symptoms. If the stomach will not tolerate either food or stimulants, they should be given by injection, and life may be greatly prolonged by this mode of feeding alone.

Erysipelas has been mentioned as one of the complications that may arise during the treatment of a wound, and as this frequently occurs when the wound is associated with a fracture, a few words upon the subject are necessary at this point while considering compound fractures. Erysipelas following a wound, or "*traumatic erysipelas,*" may happen at any time after a wound is received, and is developed in one of two forms, viz., *simple*, in which the skin is mainly affected, or *phlegmonous* (from a Greek word, meaning "to burn"), which involves the fat and tissues under the skin. In both cases there is a red eruption upon the skin, which is bright in the simple form, and dark or purple in the deep-seated. It begins as a small red spot, and grows rapidly, while the surface is studded with little blisters, called *vesicles*, filled with a clear tea-colored fluid, which soon becomes darker in color, the vesicles drying into scabs. The surface of the skin in the simple variety is smooth and hard, while in the other it is softer, with a *quaggy* or doughy feeling to the touch; moreover, the vesicles are larger, and the pain is more intense. These symptoms increase up to the sixth or eighth day, when the simple form begins to subside, and in the phlegmonous variety matter begins to pour out profusely, and large masses of dead tissue are thrown out of the wound. This is called *sloughing*. In bad cases extensive mortification may occur. The patient, from a highly feverish state at first, passes into a condition of complete exhaustion, with cold limbs, rapid breathing, feeble and rapid pulse, and profuse diarrhœa.

The *simple variety* seldom requires much treatment, beyond pure air, nourishing food, and the tincture of iron internally. If the bowels are constipated, give a small dose of Rochelle salt. A weak wash of sugar of lead and water [a drachm to a pint of water] may be applied for comfort, and country people place deserved confidence in a cold poultice of mashed *uncooked* cranberries.

In the deep-seated form the treatment must be more active. Here all the rules as to disinfectants, ventilation, etc., must be carried out to the letter, as given in the directions for the treatment of pus-poisoning. The tincture of the chloride of iron should be given in doses of ten or fifteen drops, once in two or three hours, mixed with half a wineglassful of water. If the prostration increases, add two or three grains of quinine to each dose of the iron. In moderate cases, five or six ounces of wine, or two or three ounces of brandy must be given in the course of a day, and be increased if the symptoms are urgent. External applications in both forms are important to the comfort of the patient. In simple erysipelas it is sufficient to keep the part dusted with flour, or

covered with carded cotton loosely applied, and either of these may be used instead of the lead wash or cranberry poultice, if they give equal ease to the patient. In the early stage of the phlegmonous form, small incisions with the point of a sharp knife will relieve the tightness of the skin, and shorten the disease. Warm water, with disinfectants, should be applied freely, and this can best be done with the rubber-bulb syringe, and after thoroughly irrigating the surface of the limb, the open wounds should be syringed out with the disinfecting solution, both to secure perfect cleanliness and to hasten the sloughing, and favor the escape of dead flesh. A poultice of yeast, with powdered charcoal stirred in, is also very valuable as an application, and should be renewed often. [See formula in Volume II.] When maturation is excessive, and much tissue has "sloughed off," the limb becoming soft and flabby, and the muscles hanging loosely, the parts should be covered with carded cotton, oakum, or lint, and held in place by a roller-bandage, which should be drawn tightly enough to hold up and support the sagging muscles. This dressing should also be changed very often.

Special Fractures.

Fracture of the Nose.

A part of the nose is composed of cartilage or "gristle." The upper part or bridge consists of two bony plates which come together in the middle line. One or both of these may be broken and the bones beneath them crushed by a heavy blow.

The break may be recognized by the change of outline which it causes, rendering the bridge crooked or depressed. A severe bruise on one side, followed by swelling, may look like a break, but by careful feeling in the nostrils, and by running up a small wooden pencil, or a pair of long slender forceps on the inside, we can usually distinguish it.

Treatment.—Sometimes the swelling and soreness will be so great when the injury is first seen that it will be necessary to wait twenty-four hours, applying cold water and laudanum meanwhile, until the swelling goes down (a tablespoonful of laudanum to a pint of water). If the application of cold does not relieve the swelling and pain, use hot water and laudanum, or heat or cold alone if the laudanum be not at hand. Try to raise the bones or fragments of bone into position as soon as possible with the pencil or similar instrument inside the nose and the fingers outside. If there is much bleeding use ice applications, or, if necessary, plug

the nostrils with cotton or soft rags. It is very important that the fracture be properly set, or it may leave a mortifying disfigurement. If the bones will not stay in place when replaced, a plug may be left in the nostrils to act as a splint until the parts become

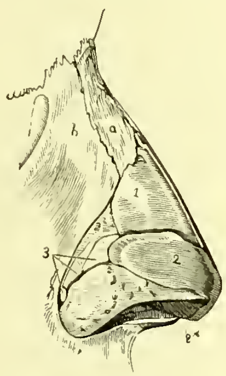


FIG. 254.

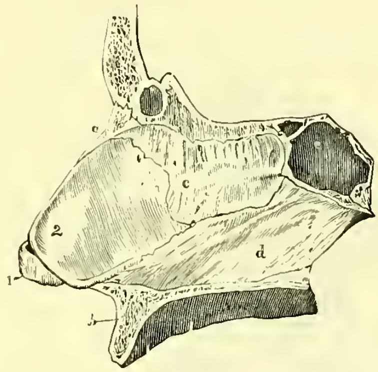


FIG. 255.

FIGURE 254.—Framework of the nose: *a*, nasal bone; *b*, part of upper jaw-bone; 1, upper, and 2, lower lateral cartilage.

FIGURE 255.—The bony and cartilaginous partition of the nose, seen from the left side: *a*, right nasal bone; *b*, upper jaw-bone; *c*, perpendicular plate of the ethmoid bone; *d*, vomer; *e*, sphenoidal sinus; 1, inner part of the cartilage of the right side; 2, the cartilaginous portion of the septum or partition.

fixed. The plug may be of wood or tightly rolled cotton, covered with oiled silk and smeared with mutton-tallow, sweet oil, or cosmoline. If no oiled silk or thin rubber is to be had, make the surface of the plug as smooth as possible and smear that. It should be removed and renewed once in twenty-four to thirty-six hours to prevent ulceration of the delicate lining of the nose.

Fracture of the Cheek-Bones and Upper Jaw.

These bones are seldom fractured except in very severe injuries of the face. The fracture will be readily recognized by the movement of the fragments, or the cracks that may be felt, and the deformity.

Treatment consists simply in replacing fragments with the fingers, and keeping them in position by adhesive plaster and bandages. If teeth are loosened they must be replaced and kept in place, and they will again become firm in their sockets. They may be fastened to the neighboring teeth by fine wire or silk.

Fracture of the Lower Jaw.

This is a strong bone, but is frequently broken on account of its prominence. It may be broken in front or at the sides; on one side or on both. The fracture may be easily recognized by the swelling, the change in the line of the teeth, the movement of the fragments, and by the grating sound caused by their movements. If the lower jaw is broken on one side, it will be twisted *toward* the injured side. If it is *dislocated* on one side, it will be turned *away from* the injured side.

FIGURE 256.—Hamilton's apparatus for fracture of the lower jaw.

Treatment.—The difficulty lies mainly in keeping so active a member at rest, and in feeding the patient. A simple apparatus for keeping the parts in place is a splint, made of gutta-percha, felt or plaster, starch or glue bandage, and kept in place by a four-tailed bandage, which is made as follows: Take a bandage six inches wide and four feet long, and split it in the middle from each end to within two and a half inches of the centre. Place the centre against the chin, bring the two upper tails around beneath the back of the head, cross them and bring them forward and fasten them on the forehead. Bring the two lower tails up over the top of the head and tie them. Hamilton's apparatus for broken jaw is composed of a firm leathern strap which passes under the chin and buckles over the top of the head. This strap is kept in place by four others, two of which are attached to it at the temple, and pass around over the ears and buckle at the back of the head. The other two are attached to the first strap at the temple and pass forward and buckle over the forehead. There is still another strap which is attached to the first on the top of the head and passed back on the middle of the top of the skull, and joins the straps which buckle at the back of the head. Wherever there is a buckle there should be a pad placed between it and the head. It is not necessary that the apparatus sheuld be buckled very tightly. While it is on the patient must not talk or laugh. He must be fed with liquid food only. This can generally be introduced between the teeth. In some cases it may be necessary to introduce

food through the nostril by a tube, or to extract a tooth for this purpose, or what is preferable to either, let him wear what is called an inter-dental splint. This is made of cork, or wood, or gutta-percha, and is shaped like a wedge, with a groove in the upper and lower edges for the teeth. It should extend across the line of fracture. One of these on each side keeps the jaws separated sufficiently for introducing food, and gives a firm resistance to the splint or bandages upon the outside. Another, and perhaps simpler method of bandaging the lower jaw is to take a strip of cotton or linen sheeting, thirty inches long and six inches wide, split it in the middle, as directed above, to within two and a half inches of the centre. In the centre, one inch from the edge, cut a slit long enough to allow the chin to pass through it. The ends of this opening should be caught with a needle and thread to prevent it from tearing when applied. The extremity of one side of the strip is tied over the head. The other side should be tied at the back of the neck, the chin passing through the slit as shown in the figure. The knots at the top and lower part of the head are fastened together by another strip of bandage, all of the knots tied firmly. The portion of the bandage passing *over* the head may be prevented from slipping back by another strip passing across the forehead and fastened to the bandage just above the ears.

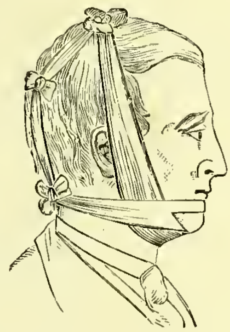


FIGURE 257.—Bandage for fracture of the lower jaw.

The splint should be worn three or four weeks, and the patient should not eat any solid food for five weeks.

Fractures of the Collar-Bone or Clavicle.

This bone is more frequently broken than any other, and a large proportion of the subjects are children. The break is commonly at the middle of the bone, and is usually oblique, so that one portion of it rides over the other. It is sometimes caused by a direct blow, but much more frequently by a fall upon the hands or shoulder, or a violent muscular action of the arm.

The signs of the fracture will be pain, inability to use the arm, drooping of the shoulders, swelling, a fissure or irregularity in the bone to be felt under the fingers, and perhaps a grating sensation when the ends of the fragments are moved. In children the so-called green-stick or partial fracture may occur here. This is almost always the result of a blow, or fall on the shoulder, and the only sign will be an oblong swelling at the point of the break.

Fractures of the collar-bone are easily set, but not easily kept in place. They unite readily, but there is almost always some deformity left. The more quiet and manageable the patient, the better the chance of perfect cure. This will require a month in an adult, and less time in a child.

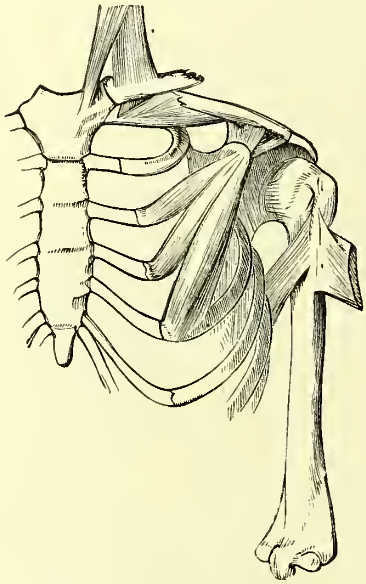


FIGURE 258.—Fracture of the left collar-bone near its middle, showing the actions of the muscles which displace the fragments.

Treatment.—The shoulder, after a break in the collar-bone, droops and falls forward and inward as the fragments of the bone ride over each other. The object of the surgeon is to counteract this tendency, and keep the bones together by an apparatus that shall raise the shoulder, and at the same time draw it backward and outward. Dr. Bartlett, of Massachusetts, devised a system of straps which effectually secures these ends. It consists of a padded ring or collar in two parts (see Fig. 259), which are buckled together, encircling the sound shoulder as a starting-point, at which the power is applied by means of straps, one of which is passed under this ring just below the ridge of the shoulder-blade, behind the shoulder, then passing across the back, this strap goes between the arm and side, then back over the arm, crossing it at about

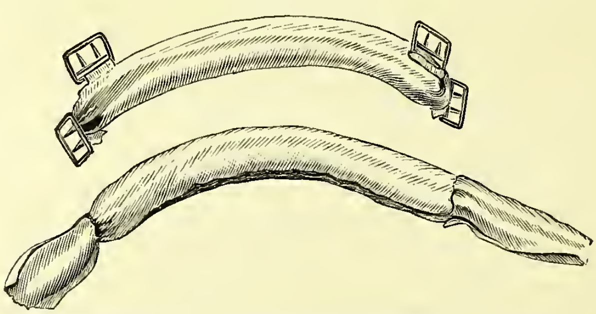
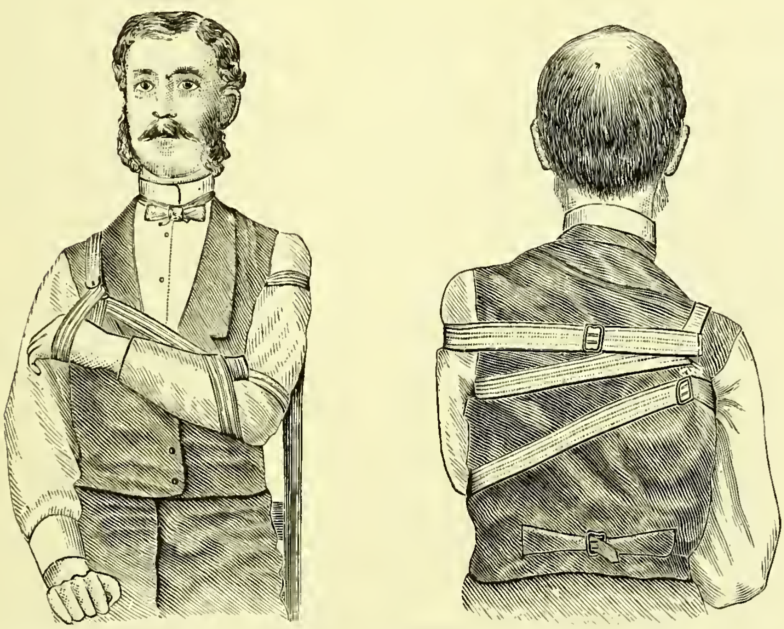


FIGURE 259.—The padded ring of Bartlett's apparatus.

its middle, and across the back to be fastened by a buckle on its other end. This draws the arm of the injured side backward and fixes its middle point. A second strap is then attached to a buckle sewn to the padded ring just below the point where the first strap passes

around it (see Fig. 261); then passing obliquely across the back to the bent elbow, goes under it and up over the outside of the fore-arm to a point even with the angle of the elbow. Here a double loop is made by winding the strap twice around two or three fingers. This loop is held firmly with one hand, while with the other the loose end is passed downward and backward *under* the *arm*, then upward and forward over the arm, *to* and *through* this double loop; then by drawing the end taut, the elbow will be held by a "figure-of-eight," one loop encircling the forearm just below, the other the *arm* just above the angle, and the *double* loop prevents either from slipping and "cording" the arm. The end is then carried upward across the chest and fastened by a buckle in front



FIGURES 260 AND 261.—Front and rear view of Bartlett's apparatus as applied for fracture of the collar-bone.

of the padded collar. By buckling this more or less tightly we draw the elbow forward more or less upon the fixed point made by the first strap, and thus throw the shoulder backward and outward, extending the collar-bone. (See Fig. 260.) A third strap is used to form a sling for the bent forearm and hand, and is also buckled to the front of the padded ring. This may be applied over the shirt, and thus enable the patient to go about with more comfort. If the long strap does not lift the shoulder enough, a pad of cotton or linen may be made and sewed to the middle of

a strip of bandage about four feet long. This pad should be crowded well into the armpit of the injured side, and the ends tied to the padded ring upon the opposite shoulder, one carried in front of, and the other behind the chest. This apparatus should be kept on for three or four weeks. The length of the two parts of the padded ring are respectively twelve and ten inches (buckles and unpadded ends unmeasured), and the diameter an inch to an inch and a quarter. The first strap should be fifty to fifty-five inches long, the second, or long one, five and a half or six feet, and the third (the sling), forty-five inches, and the width of each, one to one and a half inches.

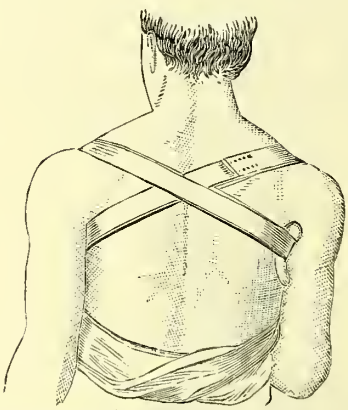


FIGURE 262.—Dressing for broken collar-bone.

A very simple dressing for a broken collar-bone, and one which can be readily made out of a pair of suspenders, or a broad bandage or strip of any kind, is represented in Fig. 262. It consists of a single strap passing in front of each shoulder, crossing and buckling on the back. It is called a figure-of-eight bandage.

Another *simple* and *effective method* is Sayre's, with sticking plaster. Two strips of plaster, four inches wide and six feet long, are required. One of these should be looped around the arm on the injured side just below the armpit, and carried across the back and around the body. The hand on the injured side should then be laid on the opposite shoulder. The other should start at the shoulder of the sound side, pass down across the back to the elbow on the injured side, a slit being cut in it to receive the point of the elbow, and up on the outside of the arm and the back of the hand to the point at which it began on the sound side.

Still another mode of dressing a broken collar-bone is to place the arm in the position indicated for the preceding dressings, laying the forearm of the injured side across the chest, the finger-tips reaching the shoulder opposite, and bind it in that position with a plaster-of-Paris bandage. The mode in which the bandage is applied will vary with the skill and ingenuity of the operator. A great deal may be done with plaster-of-Paris in dressing all fractures. Rubbed into loose muslin bandages and made into rollers, as described on page 643, or spread between layers of flannel, as in the Bavarian splint (See **Fractures of the Leg**), it can be wound or moulded into any shape, and when dry is firm and light.

When the patient lies on his back, the bones will often fall

naturally into their proper position. In a case, therefore, where it is very desirable to avoid a lump at the point of fracture, as in a young lady, if she is willing to remain in bed upon her back three or four weeks, apparatus of any kind may be dispensed with to a great extent.

Fracture of the Body of the Shoulder-Blade or Scapula.

This is rare, and is always the result of a heavy blow directly over the bone. In this fracture there is usually very little displacement, and if the swelling is great, it may be difficult to recognize it. By careful handling, the crack may be found, or the grating between the edges of the bones may be felt in the majority of cases. There is also great pain in moving the shoulder. To detect the grating of the fragments, the examiner should with one hand hold the top of the shoulder, while with the other he moves the lower end or angle of the shoulder-blade. It is difficult to keep the fragments together properly when this bone is broken, and it is usually irregular in shape when it is healed. But it makes, in the case of this bone, but little difference, as no deformity will appear.

Treatment.—In order to allow the parts to come together, the muscles attached to the upper and back part of the shoulder-blade must be relaxed by raising the arm. This is done by a sling passing around the neck and down under the elbow. At the same time the arm is to be bound to the side of the body by a bandage passing around both arms, or a large pad or folded napkin may be placed over the shoulder-blade, and held in place by long strips of adhesive plaster, carried over the pad and across the back. This helps to fix the bone in its place. Then the arm may be placed in a sling, and bound to the body as above.

Fracture of the Acromion Process of the Shoulder-Blade.

This fracture is readily made out by feeling along the ridge on the back of the shoulder-blade, until the crack and the fragments are reached. The outline of the shoulder will be flattened, as the *acromion* or point of the shoulder will be drawn downward by the muscles. There is total inability to raise the arm outward, but it can be moved in any direction by another person, who can also restore the bone to its place by slightly raising the arm.

There will generally be a slight deformity after healing, but no interference with the motion of the arm, unless the broken piece projects very far downward. It should be added that bony

union rarely occurs in this fracture, owing to the difficulty of keeping the parts in close apposition, but the ligament that does unite the bones answers every purpose.

Treatment.—If the break is in front of the joint between the shoulder-blade and collar-bone, the patient may be kept on his back in bed, with his arm straight out from his body, or his arm may be supported by a sling passing under the elbow, and a bandage binding it to the body. The sling should be short enough to bring the head of the arm-bone well up to the acromion process, and the bandage be applied tightly enough to keep it there. No pad should be placed in the arm-pit, as it would push the bone outward too far. If the break is behind the joint between the shoulder-blade and collar-bone, the shoulder and arm will fall downward and forward and inward, as in fracture of the collar-bone, and should be treated in the same way.

Fractures of other portions of the shoulder-blade are very rare.

Fractures of the upper end of the Arm-Bone or Humerus.

The fractures of the upper arm-bone, called the *humerus*, may be divided into three classes according to their location:

1. Fractures of the upper end, near the joint.
2. Fractures of the shaft or middle portion.
3. Fractures of the lower end, near the joint.

1st. *Fractures of the Upper End.*—These may again be divided into (*a*) *Impacted*, in which the lower fragment of the bone is driven and firmly fastened into the upper. (*b*) *Non-impacted*, in which the fragments are distinct and separable.

These fractures are generally caused by a direct blow or heavy fall upon the parts, the limb being struck by or striking some hard substance.

Symptoms.—There are certain signs which are common to both impacted and non-impacted fractures of the arm near the shoulder. These are: 1st. Marks of a severe blow on the part. 2d. Pain and swelling in the part. 3d. Changed outline of the part, there being in nearly all cases a hollow where the sound shoulder would show a rounded outline; and 4th, Loss of power in the arm.

There are other signs which are peculiar to the non-impacted fracture: 1st. The arm below the point of injury can be moved unnaturally in various directions. 2d. The grating between the ends of the fragments can be detected. In the impacted fracture neither of these last two symptoms are found.

A fracture of the arm near the shoulder may be confounded

with dislocation of the shoulder-joint. The points of difference are as follows :

IN DISLOCATION.	IN FRACTURE.
1st. The arm is *fixed*, and *cannot be freely moved.*	1st. The arm *can be moved with unnatural freedom.*
2d. There is *no grating* (crepitus).	2d. *Grating* between the bones *may be recognized*, *except* in *impacted fractures.*
3d. When the bone is replaced, it *stays.*	3d. When the bone is replaced, it will, if left to itself, *fall out of position.*
4th. The hand (of injured arm) *cannot* be placed on the opposite shoulder, the elbow at the same time touching the chest.	4th. The hand *can* be placed (by the patient or another) on the opposite shoulder, the elbow at the same time touching the chest.
5th. The head of the bone *can be felt out of its socket.*	5th. The head of the bone *is in its socket.*
6th. The elbow *stands out from* the body.	6th. The elbow *hangs against* the side, unless *the fragments of the bone are much out of place.*

In fractures of the arm, near the shoulder-joint, the healing process will occupy a month or six weeks, and in most cases there will be some loss of free motion, or some shortening of the limb, or both.

Treatment.—The treatment of fracture of the arm near the shoulder differs according as the fracture is impacted or not impacted. If it is impacted it is of great importance that we should not separate the fragments of the bone, for the upper fragment is very short, sometimes within the joint, and if we separate them we cannot set the bones as well as they *were* set by the same violence that broke them. We should be careful, therefore, in our examination, and, having decided that we have an impacted fracture, we should simply bind up the arm so as to put it in an easy position and keep it perfectly at rest. If we decide by the signs already given, that we have a fracture which is not impacted, we put the arm in that position in which the muscles are relaxed, and proceed to set the bones according to the directions in the general remarks on fractures (page 639), and then apply a dressing to keep it in place.

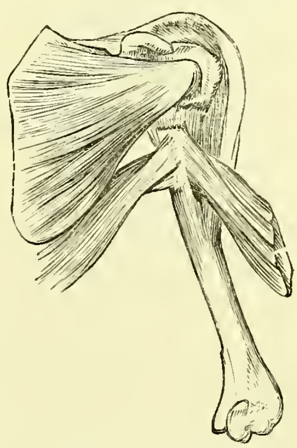


FIGURE 263.—Diagram of a fracture of the upper arm-bone near the shoulder, showing the displacement of the fragments caused by the muscles.

Dr. Hamilton's splint for fractures near the shoulder-joint is the simplest of anything thus far suggested, and is to be made of pasteboard, leather, stiffened felt, or gutta-percha. It should be long enough to reach from above the point of the shoulder to the elbow-joint, and should be cut as shown in the first figure. The notch in the upper end of the splint should be brought together with stitches, and after being dampened should be moulded to the shoulder and arm and left to become dry and hard before it is secured in its place. A second short splint should be laid on the inside of the arm, both having been previously padded or encased in sacks of woollen cloth. They are then made fast to the arm by a roller bandage, and, finally, the fore-arm being bent upon the arm, is suspended by a sling from the wrist, and the arm fastened to the side by a separate roller bandage. If there is any difficulty in keeping the bone in place by the methods described, a temporary dressing may be applied as follows :

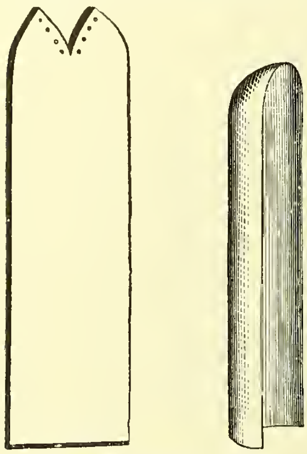


FIGURE 264.—Hamilton's splint for fracture of upper portion of humerus.

Place a thin pad, compress, or folded napkin in the armpit to fill up the hollow of that part, and thus afford a firm support for the bone. This may be held in place by strips of adhesive-plaster passing over the shoulder. Then bring the arm to the side with the elbow drawn a little forward, and pull upon it downward until the bones slip into place. The arm from the shoulder to the elbow is then to be firmly secured to the side by a roller-bandage carried around the body, or it may be fastened there by strips of plaster. The forearm may then be supported by a sling, or the hand may be placed upon the shoulder of the sound side, bringing the elbow of the injured side forward upon the chest, and fastening it there by adhesive strips, with a roller-bandage over all. It is well to commence the dressing of the fracture by covering the arm with a roller bandage evenly and smoothly applied. The elbow should be bent to the angle desired, and the bandage should commence at the roots of the fingers, covering the palm of the hand and the arm up to the point of fracture. After a few days when the swelling has subsided, the permanent splint of wood, gutta-percha, tin or felt may be applied.

Fracture of Shaft of the Humerus, or Upper Arm-Bone.

These are caused by blows on the arm ; by blows or falls on the hand, and occasionally by violent action of the muscles, as in throwing a ball. They are easily recognized by the ordinary signs of fracture: pain and swelling, inability to use the arm and hand, change in the outline of the arm as compared with the sound one, unnatural motion, and grating between the ends of the bones.

If the bone is properly set it will commonly unite without any deformity in four or five weeks. Sometimes the elbow-joint becomes stiff from being kept in splints, and frequently there is a little shortening of the limb, and, in a small percentage of cases, the bones do not unite. This last accident is more frequent in this bone than in any other.

Treatment.—Before setting the bone it is very desirable to have a distinct idea of the position and direction of the line of fracture,

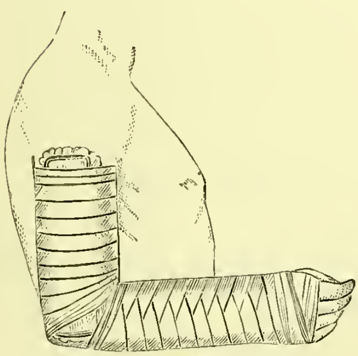


Fig. 265.

Fig. 266.

Figure 265.—Mode of dressing a fracture at the middle of the upper arm.
Figure 266.—Showing the projection backward of the elbow when the humerus is broken just above the elbow-joint.

and the manner and direction in which the muscles are drawing the fragments. This knowledge will enable us to bring them into place with the least resistance. Then put on a splint which shall extend from the shoulder to the wrist, with a right angle at the elbow. A short outside splint may be applied to the arm between the shoulder and elbow, and all should be securely bound with a

roller-bandage. Keep the arm in a sling. In this way the joints above and below the break are kept at rest, and a failure to unite, which is often caused by too much movement in the fragments, is less likely to occur than when the lower part of the arm is free. After two or three weeks this splint may be changed for one which extends only to the elbow, that this joint may not grow stiff with too long confinement. Care should be taken that the splint does not press too hard on the back of the arm, as it may injure the important nerve that supplies the muscles of that part.

Fractures of the Humerus near the Elbow.

These fractures are generally caused by a direct blow, or by indirect force, such as a fall upon the elbow. The break may be directly across the bone just above the joint, or it may be oblique, extending into the joint. In the transverse fracture, the end of the upper fragment may be felt on the front of the arm just above the elbow, and the point of the elbow will be unnaturally prominent. If the distance between the top of the shoulder and the bony prominence on the inside of the elbow be measured, it will be found to be less than in the sound arm. In all the fractures at this point we shall have the ordinary signs of fracture if we examine before the swelling is great.

The transverse fracture may be confounded with dislocation of both bones of the forearm backwards. The following are distinctive signs given by Hamilton :

IN TRANSVERSE FRACTURE OF THE HUMERUS.	IN DISLOCATION OF BOTH BONES OF FOREARM BACKWARD.
1st. *Unnatural movement.* This may be hindered in a few hours by the swelling.	1st. There is stiffness of the joint.
2d. *Grating* sound (crepitus) between the fragments.	2d. *No grating* (crepitus), though the rubbing of the bones over the inflamed surface of the joint may resemble it slightly.
3d. The bones are easily set when the arm is drawn down, but slip out at once when released.	3d. When the bones are replaced they stay in place.
4th. By measurement, the distance from the top of the shoulder to the prominence on the inside of the elbow is *less* than on the sound side.	4th. The distance between the top of the shoulder and the inner prominence of the elbow is not noticeably less than on the sound side. It is to be borne in mind, however, that no two arms are of precisely the same length.
5th. The lower end of the upper fragment can be felt, sharp, rough, and narrow above the elbow.	5th. There are no sharp points, and the lower end of the upper arm-bone can be felt, broad, smooth, and round, in the bend of the elbow.

6th. The prominence of the elbow on the back of the arm is increased by straightening the arm.	6th. The prominence of the elbow on the back of the arm is diminished by straightening the arm.
7th. This *fracture* is caused by a fall on the elbow.	7th. This *dislocation* is caused by a fall on the palm of the hand.

The great danger, in fractures about the elbow, is that the joint will be left stiff. Occasionally there is a little shortening. Sometimes there is injury to the nerve which winds around the back part of the upper arm, and supplies the muscles in the back part of the arm from the shoulder to the wrist. This causes a drooping of the wrist.

Treatment.—The splint for these fractures should extend from the shoulder to the wrist, with a right angle at the elbow. It may be of any material, and may be in one piece or in two pieces, with a hinge at the elbow. It should be lined with cloth or soft leather, and the bony prominences at the elbow should be well protected by cotton batting. The forearm should be turned, so that the thumb is upward, and should be carried in a sling. The splint should be taken off, in the case of a child, in three or four weeks, and in four or five weeks, in the case of an adult, in order that the elbow-joint may be exercised. This should be repeated every two or three days, the dressing being replaced after the exercise. If there is injury of the nerve and drooping of the wrist in consequence, the arm must be supported by a splint, and electricity be applied under the instruction, if possible, of a physician.

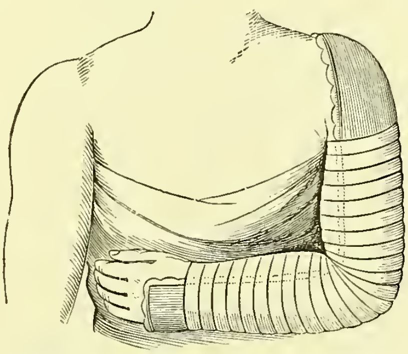


FIGURE 267.—Splint for fracture of the shaft or lower part of the upper arm bone.

An injury at the elbow usually occasions a great deal of swelling, and it may be necessary to wait until this can be reduced by applications of hot or cold water before applying the dressing.

Fracture of the Bones of the Forearm near the Elbow.

The only fracture of these bones which is likely to occur at their upper portion, is a fracture of the point of the elbow, called the *olecranon* or "funny bone." This is caused by a fall or blow directly on the elbow.

Signs.—This portion of the bone being covered only by skin, it

is not difficult to feel the crack and move the fragments, unless the swelling is great. The patient cannot straighten out his arm, and by moving the fragments a grating sound may be heard when the arm is straightened by another.

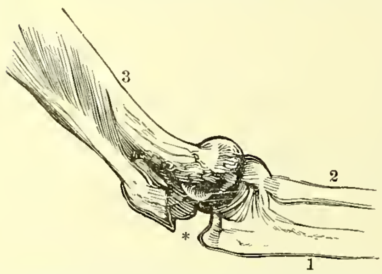


FIGURE 268.—Fracture of the upper end (olecranon) of the ulna. The * is placed between the ends of the fragments. 1, the ulna; 2, the radius; 3, the humerus.

This bone, when broken, frequently fails to unite, except by a ligament. In some cases the arm can never afterward be entirely straightened.

Treatment.—The first point in the treatment is that the arm should be straight. For when the elbow is bent, the strong triceps muscle on the back of the upper arm draws the upper fragment away from the lower one. Dr. Hamilton's splint for this purpose consists of a piece of shingle or thin board, long enough to reach from the wrist to within three or four inches of the shoulder, and as wide as the widest part of the limb. At a point three inches below the point of the elbow, this board should be notched deeply on each side, the notches being so cut that the edge next the elbow shall be transverse to the long axis of the splint, and the other edge be bevelled toward the hand. Pad one surface of the splint with cotton batting, so that it shall fit, and cover the padding with cotton cloth. Then, having the palm of the hand of the injured arm turned upward, lay the splint on the front of the arm, bringing the notches into proper position, three inches below the angle of the elbow, and bind it on with a roller bandage. Beginning at the wrist, wind it evenly up to the notches; at that point carry it up obliquely behind the upper fragment of the broken process, and draw it down, bringing the bandage to the notch on the opposite side. Make two turns in this way, and then carry it downward at every turn, on the back, bringing it each time to the notches in front, and continuing until the back of the elbow is covered: then go by even, circular turns up to the top of the splint. Before applying the roller, a small pad of folded linen, wet, to prevent its slipping, should be laid on the upper end of the upper

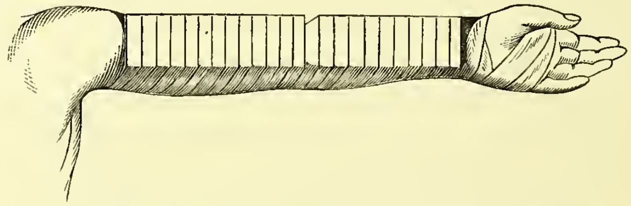


FIGURE 269.—Splint for treating fracture of the olecranon.

fragment. In three or four weeks in a child, and four or five weeks in an adult, the bandage and splint should be removed, and gentle movement of the joint should be made daily.

Fracture of the Shaft of One or Both Bones of Forearm.

This is caused by a direct blow, or a fall upon the hand.

Symptoms.—If both bones are broken, the ordinary signs of

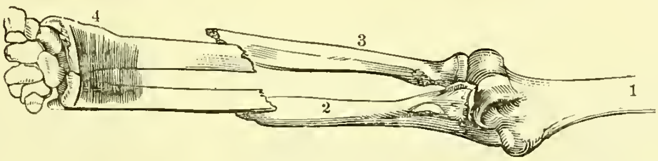


FIGURE 270.—Fracture of both bones of the forearm. 1, the humerus; 2, the ulna; 3, the radius; 4, the pronator quadratus muscle, the contraction of which tends to draw the lower fragments together.

fracture will be plain. If, however, only one is broken, there may be little change in the line of the bone, and the true condition may not, very easily or quickly, be recognized.

The loss of the power of turning the hand inward or outward, especially the latter, is one of the frequent results of fracture here. In some cases tight and careless bandaging has resulted in mortification or death of the limb.

Treatment.—In dressing fractures at this point, *no bandaging should precede the application of the proper splints*, for one of the chief dangers to be avoided is the crowding of the two bones together. They are liable to unite at the point of fracture, and this would deprive the arm of its most useful rolling motion. Two splints as broad as the arm should be used, one before and one behind. They should be well padded, and some surgeons make use of a ridge of padding along the middle of the front splint to press between the bones, and thus keep them apart. Most surgeons, however, omit this, as great care has to be taken that the ridge does not press too deeply, and thus compress arteries or nerves. Generally, if of any *use* at all, it is *unbearable.*

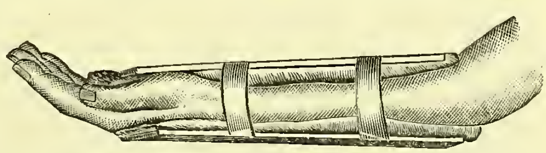


FIGURE 271.—Mode of applying splints to a fracture of both bones of the forearm.

The splint should be applied when the arm is extended, and the

hand should lie *palm upward,* afterward the arm should be bent inward, and carried in a sling, *with the thumb uppermost.*

Fractures of the Arm near the Wrist.

We may have both bones broken here, and this condition may be confounded with dislocation of the wrist. By careful attention to the signs of distinction between fracture and dislocation, given on page 707, it may be recognized. The most common fracture in this situation is a fracture of the radius, which is on the outer or thumb side, and is much larger at the lower end than the other bone. This is always caused by a fall on the hands, and is called Colles' fracture, from Dr. Colles, of Dublin, who first described it in 1814. It is called "back-door fracture," because so frequently women incur it by stepping out from their kitchens upon an icy "back-door" stone; and also "silver fork-fracture," from the shape of the wrist after this accident.

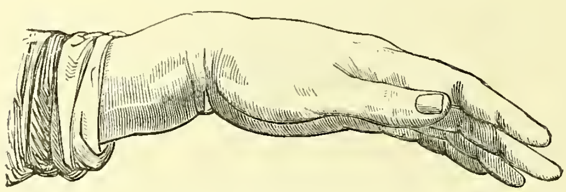


FIGURE 272.—Appearance of the wrist in a case of Colles', or silver-fork fracture.

Signs.—This injury is easily made out by the nature of the accident and the outline of the arm. The fragments of bone are very frequently impacted or driven into each other.

Results.—Some deformity usually remains after this fracture. The hand inclines more or less to the thumb side, and the end of the bone of the arm on the little finger side is prominent. A swelling generally remains for a long time on the point of the wrist, and sometimes a stiffness of the wrist and fingers is permanent. It rarely happens that the limb is perfectly restored. Death of the limb has sometimes happened from tight bandaging. The latter danger should always be borne in mind in this and other fractures. The limb should be often looked at, and if any signs of obstructed circulation, or great pain, or loss of sensibility should be noticed, the dressing should be at once removed and put on properly.

Treatment.—If the fragments are "impacted" or fixed together, the first question that arises is, shall they be separated or left to unite as they are? Do not separate them if the patient is old or feeble, or if the deformity is slight. If the patient is young and vigorous, and there is a considerable deformity, separate the fragments and reset them if it can be done without too much force. The bones may often be replaced when not impacted, by simply

pressing on the back of the lower fragment with the thumb, or it may be necessary to combine extension and rotation with pressure.

In the many different splints that have been devised for the cure of this fracture, the ends sought are: 1*st.* To keep the limb at rest. 2*d.* To draw the lower fragment down into place and keep it there. 3*d.* To oppose the bending or twisting of the hand toward the thumb side, which always occurs. Dr. Hamilton's dressing consists of two splints, which may be made of a shingle or other thin strip of wood as broad as the broadest part of the forearm, and long enough to extend from near the elbow to the fingers. The one for the front of the arm should dip down, like the runner of an ox-sled or a stone-boat, the angle being a *little less* than half of a right angle. This should be covered with a bag or sleeve of cotton cloth, which should fit snugly, and should be stuffed on the inner side with cotton batting, hair, or oakum, so that it will fit the inequalities of the arm. The one for the back of the forearm should be of the same width as the other, and long enough to extend from near the elbow to the wrist, but without any angle. This should be covered and stuffed in the same way, the part over the fracture being made a little firmer than the rest. The elbow should then be bent at a right angle, the thumb edge of the hand uppermost, and the splints bound on with a roller-bandage, which must extend to the fingers. Take care not to bind down the thumb. Put the arm in a sling. Watch the case very carefully for a fortnight, and if swelling renders the pressure too great, lessen it by loosening the bandage.

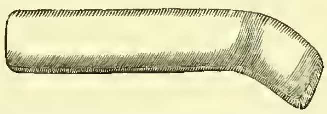


FIGURE 273.—Splint for Colles' fracture.

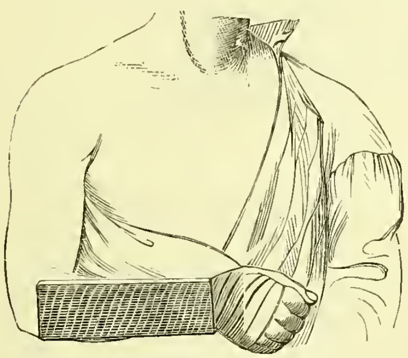


FIGURE 274.—The splint applied.

Dr. Carr, of Goffstown, New Hampshire, has recently devised a simple and very effective splint for Colles' fracture. It has two pieces. That for the back of the arm is a simple strip of thin wood (as shown in Figure 275), nine inches long and two inches wide. That for the front is of the same width, an inch longer, and has two accessory pieces, viz.: 1*st.* A piece tacked or glued to its inner surface, shaped like a vertical half of a narrow boat, spit from stem to stern. The gradually swelling side of this boat-shaped piece fills in the space which remains when a simply flat splint is ap-

plied, and serves to keep the bones pressed a little apart. *2d.* A round stick, as a piece of broom-handle, five inches long, which is fastened across the lower end of the splint inclining downward and backward. This, when fastened on, makes the splint applicable only to one hand; therefore they are made "rights" and

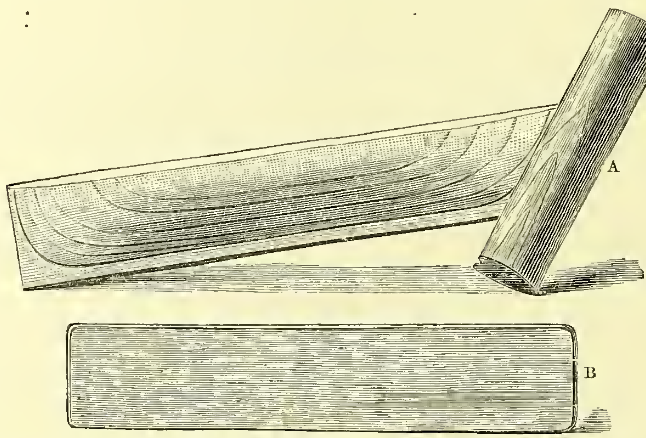


FIGURE 275.—Dr. Carr's splints for Colles' fracture. A, the part applied to the front of the arm; B, the splint used for the back of the arm.

"lefts." The arm should be well padded, and these splints applied with a roller-bandage, so that the hand will grasp the round piece at the end of the front splint. Grasping it thus will draw down the lower fragment sufficiently and accomplish the second object of treatment, and the inclination of the stick will cause the wrist to bend away from the thumb, thus accomplishing the third object of treatment. Some surgeons prefer to use splints which extend only to the wrist, putting the arm in a sling and allowing the hand to hang down, the weight of the hand effecting the second and third object of treatment.

Fractures of the Bones of the Hand.

These bones are broken sometimes by a blow across the hand, and sometimes by a blow upon the knuckles, as when the fist is struck against some hard object.

Signs.—The injury will be attended with pain and swelling, and if the fragments are much out of place, they can be recognized by touch, and perhaps the grating sound may be heard when we move them.

A little irregularity in the shape of the hand may remain, but its usefulness will be fully restored if the bones are properly set.

Treatment.—A straight splint, three inches wide and long enough to extend half way up the forearm, with a pad to fill the palm, bound on with a roller-bandage, will suffice. Sometimes a ball of cotton or woollen yarn may be placed in the hand, and the fingers be clasped over it and bandaged down in this position. That method should be chosen in each case which seems best to restore the broken bones to place and hold them securely.

Fractures of the Fingers.

These may be caused by direct violence, as when a door or a window is closed upon the fingers, or by a blow on the ends of the fingers, as from a ball.

A fracture in these bones is easily recognized. The bones will, with proper care, probably unite without deformity. But there are several ill results which may occur, and which should be carefully guarded against, as a slight deformity in the hand is very annoying, mars its beauty and interferes with its usefulness, viz. : 1st. The lower fragments may be twisted so that the palmar surface will be turned to one side. 2d. The lower fragments may unite with the upper one at an angle, inclining either backward or forward, or to one side. 3d. A joint near the fracture may be left stiff.

Treatment.—To avoid the above deformities it is important to set the bones with special care, and to watch the progress of the case, removing the dressings occasionally. Fractures of the fingers are often associated with severe injuries, which leave bad, open wounds. Sometimes it is necessary to amputate, but an attempt should always be made to save the finger if there is any prospect of success. This is especially true of the thumb. Says Hamilton : "If the bone of the finger is not only severed completely, but all of its soft coverings, save only a narrow band of integument, are torn asunder, a chance remains for its restoration." A stiff or deformed finger is generally better than none, though there are some cases in which this is not true.

The mode of dressing a broken finger is very simple. A splint should be fitted to the front of it, which may be of wood or pasteboard, or still better, of tin or zinc perforated. This should be padded and bound on with a narrow roller-bandage. Plaster-of-Paris is an excellent application for this fracture. It is well always to have the ends of the fingers uncovered, so that if the pressure is so great as to interfere with the flow of blood, it may be observed. The hand should be placed in a sling.

Fractures of the Breast-bone and Ribs.

The ribs do not break easily, except in those who are old, or whose bones are diseased. Cases have been recorded in which a violent cough, effort in child-birth, and even the beating of the heart, have fractured the ribs. These, however, are wholly exceptional. When the accident occurs, it is generally caused either by a direct blow, or a blow on the front of the chest, which bends the ribs and breaks them outward. Direct violence breaks them inward. The breast-bone is seldom broken, and direct violence is always the cause.

Signs.—Fracture of the breast-bone may be recognized by observing the movement of the fragments in breathing, and by the touch. Fracture of the ribs, if the bone is only partly broken through, or if the covering of the bone, called "*periosteum*" is not torn through, may not be discovered. If the fracture extends entirely through, the symptoms are plainer. They are pain in one spot, swelling, sometimes movement of the fragments on each other, and grating between them, difficult breathing, and pain in drawing a long breath. The difficult breathing after an injury to the ribs is not, however, a sure sign of fracture, for it may follow a simple bruise. When the broken point is driven into the lung, the flesh will be puffed up by the air which escapes from the lung. This puffing may extend only a short distance about the wound, or it may extend over the whole body. Sometimes the patient distinctly hears the cracking of the bone when the accident occurs. If, in addition to the sharp pain aggravated by deep breathing or coughing, we find the patient unable to lie down without increasing these symptoms, we may be sure the ribs are broken somewhere.

A simple fracture of a rib unites easily, and is a small matter. The serious results arise from the injuries to the parts beneath—the heart, the lungs, and the pleura. Three-fourths of the cases escape such complications and recover in a few weeks. In other cases pneumonia, pleurisy, or consumption may ensue.

Treatment.—The bones, if out of place, should be restored as much as possible by the fingers. In dressing the injury, the chief object is to restrain the constant movement of the ribs on the injured side in the act of breathing. In this way the sharp pain accompanying each breath can be relieved, and if the broken end has pierced the lung, that organ is freed from the irritation which movements of the fragments occasion. This object is best accomplished by laying on strips of sticking-plaster, two inches

wide, and reaching from the middle line of the body in front to the spine behind. These strips should overlap each other, and should extend about three inches above and below the injury. In some rare cases this may increase the pain. If so, it should be removed. The discomfort which it occasions at first will usually soon pass away, and great relief will be felt. The patient should be kept quiet, and should have light food. Where a lung has been torn, and great difficulty of breathing with extreme suffocation results, it may be necessary to bleed. In many cases, both of complete and incomplete fracture of the ribs, perfect relief may be afforded by winding a roller-bandage about the entire chest, drawing it as tightly as the patient can bear it ; or, any strip of cloth may envelop the chest closely, and be secured by a few pins or stitches. This method is always available for a temporary dressing.

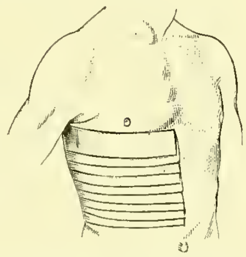


FIGURE 276.—Mode of applying adhesive plaster in strips for a fracture of the ribs on the right side.

Fracture of the breastbone should be treated on the same principle as fracture of the ribs.

Fractures of the Hip-Bone.

These bones are strong and well protected by muscular coverings. Accordingly they are seldom broken, except by a very severe accident, such as crushing between railroad cars, or under heavy weights. The fractures may be in front or at the hip-joint, or the projecting rim may be chipped off.

Symptoms.—The crack in the bones may sometimes be felt, but unless there is considerable displacement of the fragments, the fact of the fracture must generally be determined by the nature of the injury and the general symptoms.

Probabilities.—These bones form a basin which contains important organs at the lower portion of the body, and the results of the accident will depend on the extent to which these organs are injured. If this has been but little, or not at all, then there is a good prospect of entire recovery, with little deformity.

Treatment.—If any fragments can be felt, they should be restored to position as far as possible. Sometimes a broad bandage or strap should be put on around the hips. The patient should be kept quiet upon his back, with his knees drawn up, and his thighs supported in that position. In some cases a different posture may be best. Find out whether water is passed regularly, for the bladder is sometimes so injured in these fractures that the urine

is retained. If this is the case, it must be drawn with a catheter. When the fracture is in the socket of the hip-joint, it is necessary to put the limb in a long splint, or to exert a constant force upon it, drawing it down by a weight at the foot of the bed, and a cord playing over a pulley. The method of applying this has been already described, but its successful use will demand more skill than most unprofessional persons possess.

Fractures of the Neck of the Thigh-Bone.

Fractures of the thigh-bone called the *femur* may be divided into three classes, according to their location, viz.:

1st. Fractures of the upper end or neck, near the joint.

2d. Fractures of the shaft.

3d. Fractures of the lower end, near the knee-joint.

1st. *Fractures of the Upper End or Neck.*—These may be again divided into (*a*) Impacted, in which the lower fragment of the bone is driven and firmly fastened into the upper; (*b*) Non-impacted, in which the fragments are distinct and separated.

These fractures belong peculiarly to advanced life. As old age comes on, a change takes place in the shape of the bone. The neck, instead of being set obliquely on the shaft, seems to bend down until it forms a right angle with it. There is a change, also, in the structure of the bone. The cells in the interior become large, and the solid part grows thinner. It is said that in old age the proportion of mineral matter in bone is greater, and of animal matter less than at an earlier period. For these reasons the bone is more brittle and less fitted to sustain a violent strain. The neck of the thigh-bone is covered so deeply by muscles, that it is seldom broken by a direct blow. It is commonly by indirect violence that this accident takes place, as a fall upon the feet or knees, or upon the bony prominence upon the outer side of the hip. The bone may be so brittle as to be broken by the sudden contraction of the muscles. Sometimes the causes are surprisingly slight, as a trip on a carpet, or missing a step on the stairs, or getting the foot caught in turning over in bed. Any such accident followed by pain, inability to walk, or lameness, in an old person, should lead us to suspect such a fracture.

The signs which are found in *both* impacted and non-impacted fractures of the neck of the thigh-bone are: 1st, a blow or fall upon the foot or knee, or upon the outside of the hip; 2d, pain and swelling; 3d, change in shape, the outer side of the hip being flatter than the corresponding side; 4th, the foot is turned out-

ward; 5th, the limb is shortened; 6th, there is loss of power to use the limb.

Signs which are found *only* in non-impacted fractures of the neck, are: 1st. Unnatural motion of the limb. When the sound thigh is turned inward and outward, it pivots on the head of the thigh-bone and the head is in the socket. When the neck is broken, it pivots at the point of fracture and turns in a smaller circle; 2d. The grating heard and felt between the ends of the broken bone.

In an impacted fracture of the neck of this bone, neither of these two signs are found. Sometimes the foot will be straight or even turned outward. In the impacted fracture the limb, which is shorter than the sound one, cannot be drawn down to its natural length without violence. The length of the limb is to be determined by measuring from a bony prominence on the front of the hip-bone to the side of the knee, being careful to take the same points on both sides. In the impacted fracture, the distance from a bony prominence on the front of the hip-bone to the outside of the thigh-bone will be less on the injured than on the sound side.

Fracture of the neck of the thigh-bone is liable to be confounded with dislocation of the hip-joint. In both we find these common signs: 1st. Pain and swelling. 2d. Shortening of the limb. 3d. Inability to use the limb.

We find in Dislocation of the Hip:	*In Fracture of the Neck of the Thigh-Bone:*
1st. Fixedness of the limb in one position.	1st. The limb can be easily moved by another person.
2d. The head of the bone is felt out of position.	2d. The head of the bone cannot be felt.
3d. The foot is generally turned *inward.*	3d. The foot is generally turned *out.*
4th. There is no grating (crepitus).	4th. There is grating, unless the fragments of the bone are impacted.
5th. When the bone is replaced it stays, but it is difficult to replace it.	5th. The bone can be easily replaced, but it does not stay in position.

This fracture is most common in old and feeble persons. In such cases the prostration caused by the injury is sometimes great, and a low fever may follow, with general exhaustion, which may destroy life within a few months. In no case does perfect recovery take place. Frequently the bones do not unite, and frequently they unite only by ligament. Shortening of the limb and lameness always remain. The shortening varies from one-fourth of an inch to two and a half inches. In many cases, however, the immediate effects of the accident soon pass off, and after two or three months the limb is restored to usefulness.

Treatment.—The treatment differs according as the fracture is

impacted or not impacted. It is important, therefore, at the outset to settle this question. If impacted, it is of the utmost consequence to avoid any rough examination or efforts to draw the lower fragment down. The leg should be dressed in such a way that the broken bone shall be kept perfectly quiet. In this way union will usually take place. If the fracture is not impacted there are three objects of treatment: 1st, to set the bone; 2d, to keep it drawn down in opposition to the tendency to draw up and shorten; 3d, to keep it perfectly still. The first is to be done by drawing down the leg, and, while an assistant holds back the hip, firmly making a steady pull in the opposite direction, the bones are gently twisted into place. For the second and third purposes, splints and extension apparatus are to be used. The splint should be a long strip of board four inches wide and extending from the armpit to a point a few inches below the sole of the foot. An upright foot-piece may be fastened across the lower end. This splint should be well padded and applied to the side of the body and leg as the patient lies on his back in bed with the limb set. It should be bound on with broad bandages around the body and narrower bandages from the foot to the thigh.

There should be a perineal or "crotch" band—that is, a band passing through a slot in the splint four or five inches above the hip, down under the thigh and between the legs, and back to the point where it started, and there drawn tight and tied. This band should be made of strong linen in the shape of a bag about fifteen inches long, and about an inch in inside diameter. This should be well stuffed with hair, wool, or cotton, and a strong tape firmly sewed to each end. It should be covered with oiled silk or muslin and placed between the legs, as directed, while the tapes serve to fasten it to the slot in the splint. This band exerts what is called "counter-extension," because it holds the upper portion of the thigh against the force which draws the leg downward. This latter force, which is called "extension," is applied in two ways:

1st. By the action of the splint alone. When the splint is put on, the leg is drawn down upon it (the perineal band holding back the hips above), and is bound to it by the roller-bandage; the foot-piece extends a little below the sole of the foot, and, the bandage passing back from it on the foot, assists in holding it down. Thus a considerable degree of extension is exerted, which is all that is needed in some cases, as where the fracture is partially impacted.

2d. By the application of sticking-plaster to the sides of the leg, with ends sufficiently long to fasten below the sole to a cross-

piece or stirrup, four inches long and two inches wide, to which is attached a cord, which passes through a pulley at the foot of the bed, and has a weight on the end of it. The weight for this fracture should not exceed eight or ten pounds for an adult. This is called the Crosby method, because it was first brought forward by Dr. Josiah Crosby, of New Hampshire, and should always be employed where any considerable degree of extension is required. The perineal or crotch-band may be dispensed with in this apparatus, counter-extension being made by raising the foot of the bed a few inches, so that the weight of the body will fall toward the head. (See page 678.)

Another method, that of Sir Charles Bell, is to put the limb upon a double inclined plane, which can be readily constructed by any one who can use hammer and nails. The apparatus may be made, as described by the inventor, by uniting two boards at their inner extremities by hinges, while the end next the body is similarly fastened to a bed-piece, and the lower or longer board is left free, to be changed, as needed, from one notch to another in the bed-piece. A narrow strip of wood may be nailed to the edges of the boards to keep the cushions in place and to prevent the limb from rolling either way. The upper board should extend from the bony prominence, called the seat-bone, or "tuberosity of the ischium" (see page 735), to the heel, with the hinge directly under the knee-joint. The boards should be well cushioned, and a foot-piece must be attached to the lower end of the long board. Both the boards and the foot-piece should have holes bored in them for the passage of tapes with which to fasten the limb to the splint. The leg should then be enveloped in a roller-bandage applied from the toes to the groin, and two light paste-board splints, softened in warm water, should be secured to the outer and inner parts of the thigh, nearly meeting in front and reaching from the groin to the knee. The limb is now laid over the inclined plane in an easy, comfortable position, making the angle at the knee such as will secure these results. The foot is then attached to the foot-board and the limb secured to the splint by tapes, and finally a roller-bandage may be applied over splint and limb both.

A more simple double-inclined plane may be made by measuring the limb above and below the knee, so as to get the exact length of the two parts. Cut the boards to fit this measurement, nail them together at the angle, attach a foot-board to the lower extremity, and pad it as in the "Bell splint." Have a smooth, hard, and even bed prepared for the patient by placing boards upon the frame of a common bedstead, and upon this place a mattress made

either of hair, husks, cotton-waste, jute, or moss, and upon this set the splint. The limb is to be secured to the splint in the manner just described. A circular hole may be cut through the mattress and the flooring of the bedstead, in the manner described in the section upon "**Fracture Beds**," and the patient can then evacuate the bowels without disturbing the limb. This mode of treatment is applicable to fractures at or near the upper end of the thigh-bone, where there is a tendency to displacement of the upper fragment. It is also useful in fractures just above the knee-joint, and in cases where open wounds at or near the seat of fracture require constant attention. In this, as in all other serious injuries, the attendance of a surgeon should be secured as soon as possible to decide upon the character of the fracture and to correct any errors in the application of the dressings.

Fractures of the Shaft of the Thigh-Bone.

These are commonly the result of direct violence, as the passage of a wagon-wheel over the limb, or a severe blow upon it. Sometimes they are caused by a fall upon the feet. In an adult the bone seldom breaks straight across, but commonly in a slanting direction, so that one fragment slides up on the other. In children the fracture is often straight across the bone.

Symptoms.—Pain, swelling, loss of form in the limb, unnatural movement when the limb is handled by another person, grating between the fragments, shortening of the limb, from half an inch to an inch and a half, or very much more, and turning of the foot outward, are the signs of this fracture. To measure accurately the two legs, in order to ascertain the amount of shortening, proceed as follows:

Place the patient, stripped, upon the back on a flat, hard surface, as a table or the floor, with the legs exactly on a line with the body. Take a tape-measure or string, which should be *perfectly inelastic*, and place the edge of the thumb-nail on the line which marks the beginning of the scale, or on a small knot tied at one end of the string. Find the sharp corner of the hip-bone in front, called the "anterior superior spine of the ilium," and press the end of the tape-measure with the thumb-nail, which rests upon it (or the knot) from below upward firmly against this point. Measure down to the bony prominence on the outer side of the ankle. Be sure that your points of beginning and ending are exactly the same on both sides. Some surgeons consider the navel as the most accurate point from which to measure, being careful

to keep the pelvis (or hip-bones) exactly at a right angle with the central line of the body.

It is evident that measurements of legs, unless made with skill and great care, are liable to be inaccurate. This may account for the fact that some eminent surgeons have claimed that if a fractured thigh is well treated it will recover without permanent shortening, while the great majority of authorities hold and affirm that, 1st, as a general rule, all fractures of the thigh in the adult will be followed by a shortening of the limb of from one-fourth of an inch to one and one-half inches, whatever may be the skill of the attending surgeon ; 2d, that in children recovery without shortening occasionally takes place ; 3d, that at any age, if the fracture is directly across the bone, and the fragments are not out of place, recovery, without any shortening, may be expected. If the difference in the length of the limbs is slight, there will be no limping. Indeed, *few sound people have legs of exactly the same length.* In some a difference of three-fourths of an inch will not be observed at all in their walk. [And the only observable evidence of it, in case of men, may be an apparently greater length of trousers leg on the shorter side.]

If there be no extensive injury to the neighboring parts in connection with the fracture ; if there be no open wound and no destruction of large nerves or blood-vessels, the danger to life is slight. Quite probably some weakness of the injured limb will remain after the fracture is fully healed. Two or three months will be required to complete the union of bone and render the limb sound and safe, and it is well that some firm dressing should be worn for a month or two longer. Whatever mode of dressing the fracture be adopted, if the knee is kept in one position for six or eight weeks, the joint will be stiff when the splint is removed. This stiffness must be treated by both active and passive motion, persisted in for a long time, as the natural movements of the knee are rarely ever fully restored under six to twelve months.

Treatment.—The treatment of this fracture has received a great deal of attention, for several reasons : The weight of the limb makes it more difficult to keep the fragments in position and at rest than in the case of other fractures. The bone is large and slow to unite. The ends of the fragments are so bevelled that they slide upon each other, and the muscles that act upon the parts are so large and powerful, that the fragments will rarely remain in place when they are set ; hence all the skill and ingenuity of a surgeon is taxed to avoid shortening or to keep it within due limits. The methods of treatment may be divided into three classes. *First.* Those which undertake to prevent shortening by placing

the limb in such a position that the muscles will be relaxed. *Second.* Those which undertake to prevent shortening by putting the limb in a straight position, and applying an apparatus which shall steadily draw down the lower fragment. *Third.* Those which take advantage of both these means of effecting the object.

The principles of the first class may be applied in this way: Bend the knee and the hip-joint, and turn the leg upon its outer side. Make a long wooden splint, to extend from the hip to the ankle, with an angle at the knee. This may be cut out of one broad board. Pad it with cotton batting, and placing it under the leg, as it lies upon its outer side, bind it on with a roller-bandage. Put a short splint opposite, on the inner side of the thigh, and caution the patient to keep this position. Erichson speaks highly of this method in fractures in the upper third of the bone.

Another method involving the same principle, is to place the leg upon a double inclined plane. The manner of making this has been described in the section upon **"Fractures of the Neck of the Thigh-Bone."** The leg may be bound to this with bandages, and short splints applied in addition, to the sides of the thigh. In this way the muscles are relaxed, and the weight of the lower part of the leg below, and of the body above tends to keep the thigh extended.

The methods of treatment of the second class are to place the limb in a straight position and keep the lower fragment drawn down by splints or by a weight and pulley.

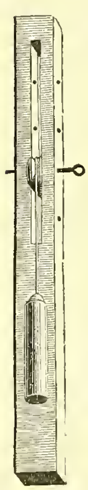


FIGURE 277. —The standard, pulley and weight.

One of the best is that of Dr. Hamilton, and is described as follows: Prepare the bed by elevating its foot three or four inches, by blocks under the foot-posts. Make a "standard" of a strip of board four inches wide and three feet long, with a slot in it a foot long. In this slot a pulley must be placed, supported by an iron pin. Several holes should be bored for this pin, that the pulley may be raised or lowered. If a pulley is not to be had, a spool will do. Fasten this standard to the foot of the bed. Have weights of some kind prepared (a bag of stones or bricks will answer) of from five to twenty pounds for an adult; for a child, one pound for one year, and a half-pound additional for each additional year, or more if necessary, to keep up the extension. The weight is to be fastened, at the proper time, to the end of a yard of rope, which is to run through the slot and play over the pulley.

Next prepare the adhesive plaster, by cutting a strip four feet and eight inches long, of the shape represented in the figure. The

wide part in the centre is five and a half inches wide and sixteen inches long. The narrower portions are each twenty inches long and two and a half inches wide at the narrowest part and four

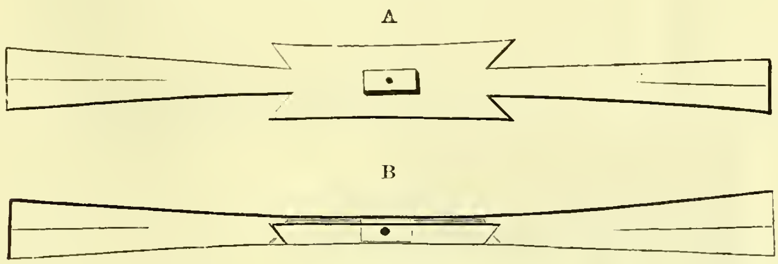


FIGURE 278.—Form of adhesive strips applied to the leg for the purpose of making extension: A, the block placed in the centre of the strip; B, the sides of the plaster folded over the block so as to hold it in place.

inches at the widest. The central portion is to be folded on itself, giving three thicknesses, and thus increasing the strength of the part where the greatest strength is required. The foot-piece is a strip of wood four inches long and two and a half inches wide, with a hole in the centre for the rope to pass through—a knot on the inside holding it firmly. The central portion of the adhesive strip is to be folded over this "stretcher."

Prepare four splints of such width, that when they are placed about the thigh, they may nearly cover it, leaving not more than an inch between them. These may be made of leather dampened and moulded to the limb, or of strips of wood or stout pasteboard. These strips may be fitted by covering them with bags of cotton cloth, and stuffing them on the inner sides with cotton. The splint behind the limb is the most important, and must be long enough to extend from the crotch to the calf of the leg. It should be wider than the others. Four or six strips of strong bandage, each a yard long and two inches wide, should be stitched at their centres to the cotton bag that covers the lower splint, so as to lie crosswise to it. These are to surround and tie on all the splints. One more splint must be provided—a long one—to extend from a point just below the armpit to five inches below the foot; this should be, for an adult, four and a half inches wide, and half an inch thick.

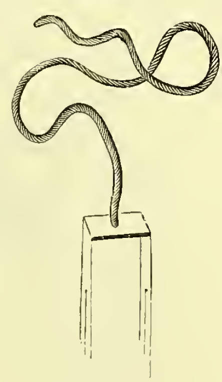


FIGURE 279. — The rope for attaching a weight to the adhesive strip, fastened to the foot-block or "stretcher."

The object of this splint is simply to prevent the foot from turning outward, and to secure this end there should be a cross-

piece two feet long, three inches wide, and half an inch thick, fastened across its edge at its lower extremity. Having at hand

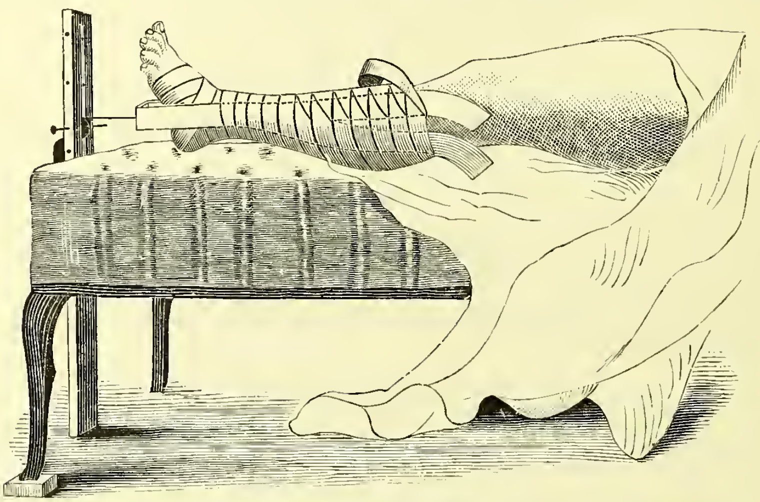


FIGURE 280.—Mode of applying the adhesive strip to the leg to secure extension.

roller-bandages and cotton batting, proceed to apply the dressing to the patient. He, lying on his back, an assistant holds his knee firmly, while another seizes the foot and draws it down. The extremities of the prepared adhesive strips may then be applied to the sides of the leg, with the tripled centre, containing the foot-

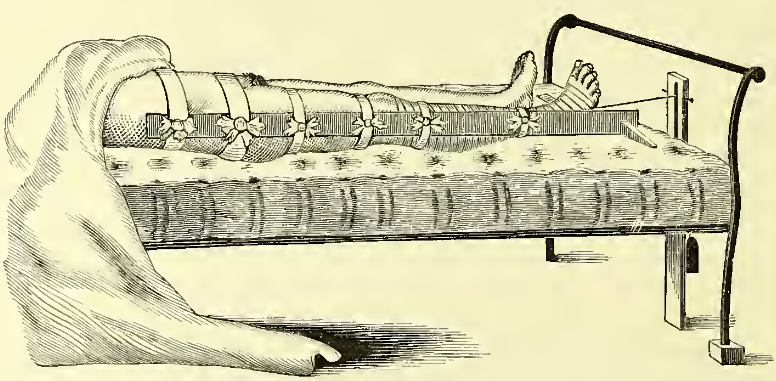


FIGURE 281.—The side-splint and apparatus for extension applied. The short splints surrounding the thigh are not shown.

piece and rope, an inch below the sole of the foot. Then apply a roller-bandage from the toes to the knee over the adhesive strips. A little cotton batting should be laid about the heel and upon the instep before putting on the roller. Fasten the weights to the end

of the rope, which has already been fastened to the foot-piece and passed through the pulley, and the extending force will then be in operation.

Now proceed to apply the splints to the thigh, tying the strips of bandage, which are stitched to the back of the lower splint, firmly over the front splint. Then lay the long splint at the side of the body and tie it to the body and the leg with strips of bandage. The limb should be carefully watched, and, if necessary, the bands which hold the splints should be loosened or tightened. It will take six or eight weeks for the bone to unite, and for two months longer, after the patient has left his bed, crutches should be used.

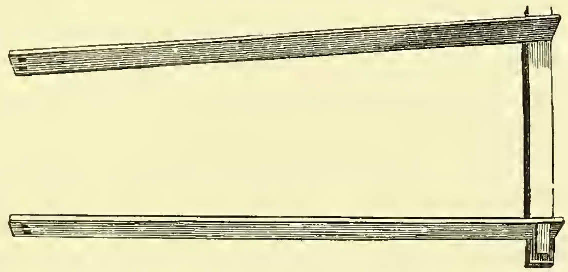


FIGURE 282.—The double side-splint used for fracture of the thigh-bone in small children.

In the case of young children, the above plan is modified by using two long side-splints instead of one, and these are joined together by a cross-piece. The object is to keep the sound limb quiet, as, in restless children, the broken limb cannot otherwise be kept at rest.

The above method makes it necessary for the patient to remain on his back for many weeks. In some cases it is desirable

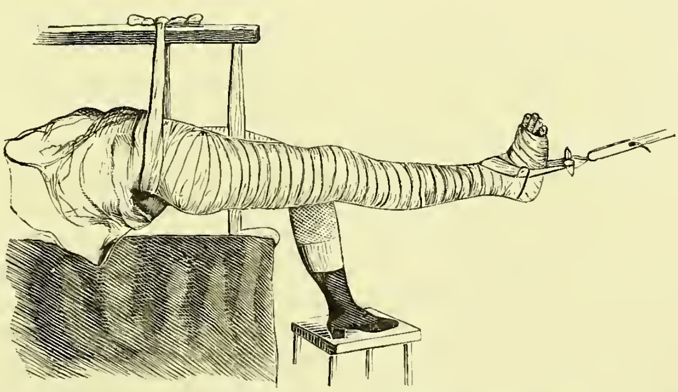


FIGURE 283.—Method for supporting a patient and for making extension during the application of a plaster-of-Paris bandage in a case of fractured thigh-bone.

to avoid this. A plaster-of-Paris dressing is then of great value. The several steps of its application are as follows: The first

point is to secure a thorough extension of the limb while the plaster is being put on and is hardening. If the lower fragment can in some way be drawn down and held there while the plaster sets, the limb will then be encased firmly, and the patient may sit up and move about upon crutches without disturbing it.

To secure this extension, prepare an ordinary table by boring through its end a hole two inches in diameter, through which a bar may pass, extending two feet above the surface of the table, reaching the floor below, and made fast to a cross-piece between the legs. From the top of this bar another one passes to the other end of the table and rests on a bar like the first, or upon a box or other support. One or two hours before the main dressing is applied, a plaster-of-Paris bandage should be put on the foot and leg up to the calf, the surface of the foot and leg being first covered with cotton batting or soft cotton cloth, making it thicker over the ankle than above or below. When this dressing is hard a bandage can be tied around it and attached below the sole of the foot to a rope which passes through pulleys. A very strong force can thus be applied to draw the limb down without cutting or improperly compressing it. Having now the table prepared, a hard plaster splint on the foot and lower part of the leg, and roller-bandages filled with plaster in readiness, you are prepared to apply the dressing. Place the patient upon his back on the table, under the horizontal bar, with the upright bar or stanchion between his thighs pressing up by the side of the injured limb. This upright should be well covered with soft cloth, and its object is to hold back the body and upper portion of the thigh against the force drawing the limb downward. Raise the hips from the table by means of a broad bandage passing beneath them and tied to the bar above. Cover the whole limb with soft flannel or a piece of woollen blanket, and fit it as neatly as possible. Then give the patient ether to relax the muscles, and apply the force to the rope attached to the lower part of the leg until the leg is as long as the sound one. Having soaked the bandages (already filled with dry plaster before rolling them) two or three minutes in water, wind them on the limb smoothly but not tightly, in small successive thicknesses, sprinkling dry plaster on the surface frequently and smoothing it with the hand. When the limb is well encased, allow the patient to remain in the same position for twenty or thirty minutes until the plaster sets. Then put him in bed and keep him there three or four days. After that he can move about on crutches. *This dressing must be carefully watched lest it be too tight.* If there is much pain, and if the toes become dark and lose

their feeling, it must be cut off. If it becomes too loose, a fresh one must be put on.

Many other splints have been invented which act on similar principles. Any person can make one by observing the following points: 1st. Provide a long outside splint only, or an outside and an inside splint coming as high as the crotch, which are joined by a cross-piece below the foot. 2d. Make counter-extension by a perineal band (already described on page 672) attached to the head of the bed or to the upper part of the outside splint, or by simply raising the foot of the bed, so that the weight of the body will be the counter-extending force. 3d. Make extension by the bandages which hold the leg to the long outside splint, or by a screw in the foot-piece, by turning which a cord is tightened and draws the foot and leg downward, or by a weight and pulley. In all these cases extension should be made by sticking-plaster extending from the leg to the foot-piece or to the rope. The screw is a simple contrivance to draw the foot-piece downward.

The third class of methods of treatment combines the advantages of the other two: namely, by bending the leg and relaxing the muscles, and at the same time drawing down the lower fragment by a weight and pulley. A good specimen of this class is that recently prepared by Dr. Brock, of Massachusetts. He puts the limb on the double inclined plane already described (page 673). He fastens to the foot of the bed, which is raised higher than the head, an upright standard similar to the one used in Dr. Hamilton's apparatus, but longer, so that the pulley will be raised higher. He then applies the adhesive plaster to the sides of the thigh below the fracture; the adhesive strips being fastened together over a bit of wood perforated for the rope, and placed just below the knee. Then, having padded the limb, he puts on short splints in front and on each side, and covers them with a roller-bandage. The limb, being placed on the inclined plane, the pulley is raised so that the rope passing through it from the foot-piece (which in this case is a knee-piece) shall draw in line with the limb above the knee. The difference between this and Dr. Hamilton's method is that the adhesive plaster is applied above the knee instead of below; the limb is bent instead of straight, and in a double inclined plane being used instead of the long side-splint.

The number and variety of the dressings for this fracture indicate not only its severity, but chiefly the difficulty of curing it without leaving the limb shorter than its fellow. No apparatus has thus far been devised which will uniformly accomplish this object, and hence the services of a surgeon should be secured at the earliest practicable moment.

Non-union of Bones after Fracture.

It sometimes, though rarely, happens that the bone does not unite properly. We may then have either of the following conditions.

1st. A union by cartilage between and around the ends of the bones, which does not harden into bone, but remains flexible.

2d. Between the smooth and rounded ends of the bones fibrous ligaments may effect a partial union.

3d. A so-called false-joint may be formed, having a capsular ligament and synovial membrane, like a true joint, and allowing unnatural motion in the limb at the point where the fracture took place.

4th. The ends of bone may be smooth and entirely disconnected —loosely moving beneath the skin.

The causes of this failure, which more frequently happen in the thigh and upper arm than elsewhere, are both general and local.

General causes are: 1st. Any debilitating disease, as consumption, scurvy, cancer.

2d. Some peculiarity of constitution.

Local causes are: 1st. Too much movement of the fragments, as when the dressing does not properly confine the limb.

2d. A portion of tendon or any other substance between the ends of bone.

3d. Arrest of the circulation of blood from tight bandages or any other cause.

4th. Injury of the nerves supplying the parts with life.

5th. Moist dressings.

When, after a lapse of a sufficient time, the fragments remain ununited, as shown by their still moving separately and grating upon one another, measures should be taken to stimulate the process of repair. Sometimes the debility which occasions the failure is the result of confinement in bed. In that case a plaster or other firm dressing should be applied, and the patient allowed to move about on crutches and get fresh air and exercise. The general health should be improved by all means possible. If any disease exists it should be combated by the proper remedies. The fragments should be placed and held close together. It is sometimes beneficial to remove the bandages every day and rub the limb with liniment to improve the circulation of blood in it. If these simple measures fail, more active ones should be employed. If the ends of the fragments are briskly rubbed together for a few minutes and then put at perfect

rest again, the stimulus may be sufficient to cause them to unite. Other methods requiring skilful management are: inserting long needles between the ends and leaving them in a day or two, or drawing a silk ribbon through in proximity to the ends of the fragments; boring holes with a gimlet in the ends of the bone and driving in ivory pegs, and allowing these to remain for a few weeks. The object of these proceedings is to excite inflammation in the broken ends and in the neighboring parts, which shall cause the bone-forming substance to be poured out. Sometimes it is necessary to insert a narrow-bladed knife and cut the ligament which unites the ends. Sometimes the ends of the bone must be cut off, in order that fresh surfaces may be formed. If all means fail, the patient must be content to wear some kind of firm apparatus upon the limb, which will partly compensate for the want of firmness at the point of fracture. None of these operative methods to secure the union by bone should, however, be resorted to by non-professional persons, for these cases are among the most perplexing in the domain of surgery, and none but surgeons should undertake them, except under circumstances of the direst necessity—for instance, if the patient be in the wilderness, or on shipboard, far beyond the reach of medical aid, an intelligent friend might be justified in thus attempting his relief after carefully studying the anatomy of the part.

Fracture-Beds.

In a fracture which makes long confinement in bed necessary, it is difficult, and at the same time very important, to keep the bedclothes under the patient fresh and clean by frequent changes.

Various fracture-beds have been invented, which are so contrived that the clothing may be changed without disturbing the patient, and that the excrement may be passed without soiling the sheets. These are sold by instrument-makers. An ordinary bed may be adapted to the latter purpose in the following manner: At a point opposite the patient's hips, substitute for one or two of the slats which support the mattress, a wide strip of board with a hole ten inches in diameter cut in it. The piece which is cut out should be replaced and held with a hinge upon one side and a bolt on the other, or a bolt may be placed on each side, or the cover and cushion above it may be supported upon a stool or a box of the right height. A corresponding hole should be cut through the mattress, the edges sewed up and covered with oiled silk or rubber cloth. The piece or cushion cut out of the mattress may be covered and replaced, and the sheet should also be cut in a similar

manner. A vessel may be placed, when required, beneath this opening, and the cover and cushion replaced when no longer needed. Its smooth sides are easily kept clean, and when not in use the hole is filled and the surface of the bed kept smooth. A bed

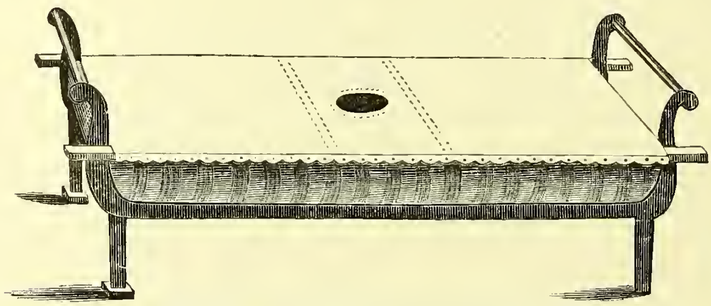


FIGURE 284.—Dr. Hamilton's fracture-bed.

thus prepared may be used during the treatment of a fracture of the thigh or leg with all varieties of splints and dressings.

[Another and simple method of making a fracture-bed proposed by Dr. Hamilton is shown in the adjoining illustrations. It consists of a sheet of canvas or heavy muslin tacked on a wooden frame, the side-pieces of which should be made long enough to project at

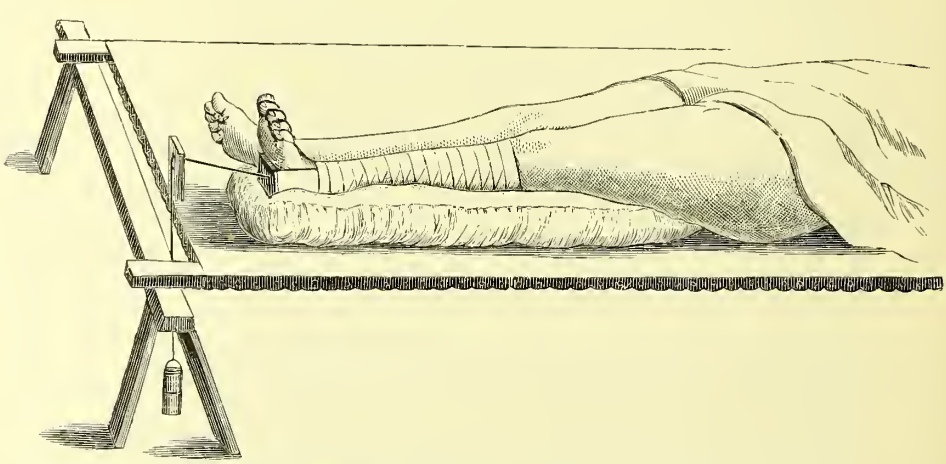


FIGURE 285.—Dr. Hamilton's fracture-bed supported on trestles, with an upright piece and pulley at its foot for extension.

the ends. The frame should be wider than the bed, so that when laid on the mattress the canvas will lie on the latter. At about the centre, or where the hips will come, a second piece of canvas or muslin should be placed below the first, as shown by the dotted

lines, and a circular hole, eight or ten inches in diameter, should be cut through both, and be bound about its edge with tape or similar material.

When there is occasion to provide for a movement of the bowels, the frame and canvas may be raised from the mattress, and either rested on chairs or benches, as shown in Figure 285, or a couple of boxes of convenient height may be placed between the frame and the mattress, so as to raise the canvas far enough from the bed to admit a bed-pan or chamber-vessel.

One advantage of this plan is the facility it offers for making up the bed or turning the mattress. The under-sheet should be cut in two, and laid upon the canvas, so that its adjoining edges overlap without wrinkles. By separating the edges a few inches, the central hole will be uncovered.

One or the other of these methods is much less troublesome for a patient confined for a long time to bed than is the use of an ordinary bed-pan.]

Bad Union.

If the bone is not properly set, or if, having been set, it is not afterward properly dressed, it may appear after two or three weeks that it is reuniting in such a way as to leave a crooked or otherwise unshapely limb. At this time the new substance, which unites the ends, has not hardened, and may often be put in proper shape and held by properly applied bandages, pads, and splints. If it has consolidated, it may be necessary to break it, having first put the patient under ether, and then to put it up again in proper form. Occasionally a limb that is shapely when the splints are taken off, will yield and bend out of shape as it is used, and hence comes the necessity of great caution in throwing the weight of the body upon this limb for a long time after the patient is upon crutches. In such cases a surgeon should always be consulted.

Fracture just above the Knee.

Either of the bony prominences on the outer and inner side of the knee, called the *condyles*, may be split off, or the break may extend directly across the bone just above the joint; or, if the accident is very severe, the end of the bone may be broken into many pieces. In the latter case amputation will frequently be called for. The fracture may be impacted, that is, the ends of the fragments may be driven into each other and hold fast. The

fracture is caused by a direct blow upon the knee, or a fall upon the foot or knee.

Symptoms.—As the muscles at this point are not thick, it will be easy to recognize this fracture by the ordinary signs. The cracks in the bone can be felt, the fragments can be moved unless impacted, and grating can be heard between them. The transverse fracture might be confounded with dislocation of the knee-joint, but a careful examination would readily distinguish between them.

Results.—When these fractures open into the knee (as they may do), there is great danger of a stiff joint. Indeed, the joint may become so much affected as to render amputation necessary. If the joint escape injury, the limb will be restored in two or three months, with, perhaps, a little shortening.

Treatment.—If one of the bony knobs, called *condyles*, on either side of the lower end of the bone, is split off, the fracture opening into the cavity of the joint, the bone should be set and a long splint made of pieces of boards should be placed upon each side of the limb, from the hip to the ankle. These should be bandaged on after being well padded. The knee-joint should not be covered, and it will be necessary to apply ice or cold cloths to it for a long time, to reduce the inflammation which will probably arise. Instead of the splints, a long box may be made, and well cushioned, in which the limb may be supported and kept straight without bandages. In a few weeks, if the bones have united, the knee-joint should be moved a little every day to prevent the stiffening which is otherwise likely to occur.

If the fracture is directly across the bone near the joint, it may be impacted. If so, it is important that the fragments should not be separated, unless they have been driven into each other in such a way as to make a bend or other deformity at the point of fracture. This fracture is likely to do better if the knee is slightly bent. It may be put on a double-inclined plane with a low angle, so as to raise the knee a little. The same box which is suitable for the fracture just mentioned may also be used for this, a little pile of cotton or other padding being placed under the knee. It will often be necessary to apply cold to reduce the swelling and inflammation of the knee-joint, which is likely to occur, although the fracture may not open into it.

Fractures of the Knee-Pan.

This bone may be broken crosswise, or vertically, or in a star-shape when the violence is great enough to shatter it into many

fragments. A direct blow or fall upon the knee may break it, and occasionally a sudden effort of the muscles which are attached to it, as in falling backward or jumping.

Symptoms.—This fracture is easily recognized. There will be pain and swelling, and loss of power in the leg, so that the patient cannot stand or straighten out the limb. The crack which always ensues can easily be felt, and if there are several fragments they may be movable with a grating sound. If the fracture is transverse or at right angles with the leg, it is difficult and often impossible to detect any crepitus or grating between the pieces. The fragments are not often separated more than three-fourths of an inch, but occasionally there has been as much as three inches between them.

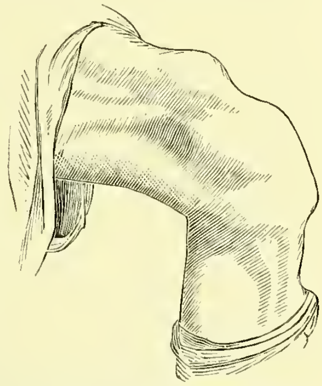


FIGURE 286.—Fracture of a knee-pan.

Results.—A broken knee-pan may be expected to unite, with proper treatment, in from one to two months. The union, however, will probably not be bony, but the fragments will be firmly united by a ligament from a fourth to half an inch long. If it is not longer than this, there will be no lameness or limping. There will probably be some inflammation of the joint at the outset, and it may be left stiff even with the best of treatment.

Treatment.—If the line of fracture runs up and down, it will only be necessary to keep the limb straight, winding a roller-bandage about the knee after the swelling has gone down. If it is across the bone, then it is plain that the strong muscle which is attached to its upper end will draw that portion up from the lower fragment, which is held fast to the bone below the knee by a strong ligament. The reason why bony union so seldom occurs here, is that it is so difficult to counteract this drawing up of the muscle, and to keep the fragments together.

The best that can generally be done, is to get a union by ligament. In order to have the ligament of union as short as possible, many forms of dressing have been devised to keep the fragments together. Some of these are quite complicated. Dr. Hamilton's method is simple and quite effective. By bending the thigh at an angle with the body the great muscle attached to the knee-pan is relaxed. Accordingly he raises the upper part of the body by pillows and puts the limb upon an inclined plane. This is made of three boards. The first, which supports the limb, is long enough to extend from the hip to the sole of the foot, and is six inches wider

than the limb at the knee. The upper end of this is hinged to a second board of the same width and a few inches longer, which lies flat upon the bed. To the lower end of this is hinged a third board two feet long, standing upright, with pegs projecting from its edges at intervals, upon which the lower end of the first board may be supported at any desired height from six to twelve inches by means of hooks attached to the lower end of the first or splint-board and carried over the pegs. On both sides of the first or splint-

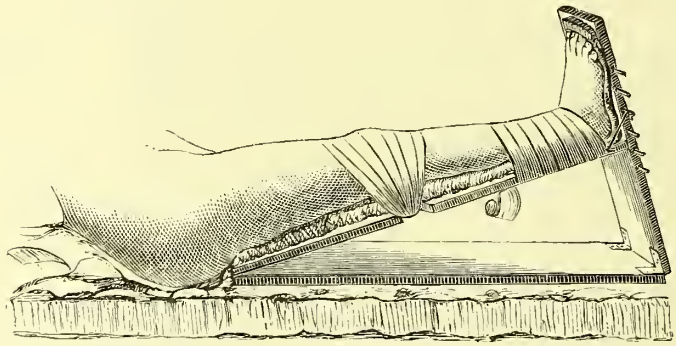


FIGURE 287.—Dr. Hamilton's mode of treating a fractured knee-pan.

board, at a point four inches below the knee, a deep notch is to be cut. Cover this board with a soft cushion which fits all the irregularities of the limb, taking special care to fill the space under the knee. Having placed the limb comfortably upon the inclined plane, apply a roller-bandage over the knee-pan. Begin at the notch and carry the bandage over the leg above the knee and down to the notch on the other side. Bring the bandage lower at each successive turn until the whole knee is covered. By this means the upper fragment is drawn downward, while the lower one is held firmly in place. Then, beginning at the ankle, wind a roller-bandage about the whole limb up to the hip-joint. One advantage of this dressing is, that the circulation in the leg is not likely to be cut off by tight bandaging, because the board over which the bandage passes is so broad that pressure is kept from the lower and outer portion of the limb. Of course no tight dressing should be put on while there is much inflammation. While this remains, a good method is to put the limb upon a long splint, fitted to its under side and well padded. Then apply cold water until the inflammation has subsided, when the permanent dressing may be applied, as directed. The temporary splint may be made of tin or leather, or a long wooden box will answer—whichever used must be well padded. Or the limb may be laid upon bed-

clothing, properly folded, and firmly supported on the sides by rolls of clothing, or, better still, by sand-bags, if attainable.

The patient should not bend the knee forcibly for three months after the accident. Then it may be gently worked back and forth, and rubbed daily to overcome the stiffness.

Fracture of the Bones of the Leg.

The leg has two bones, the larger on the inner side, called the *tibia* (whose prominent edge forms the shin), and a slender bone on the outer side, called the *fibula* or "splint bone." Either of them, singly, may be broken, or, what happens more frequently, both are fractured at the same time. The cause of a fracture of the leg is commonly direct violence, as the kick of a horse, the fall of a heavy weight upon it, or the passage of a wagon-wheel over it. Frequently it is produced by a fall upon, or a slip or turn of, the foot. The inner bone is more frequently broken than the outer, though it is larger and stronger. The reason is that it is not as well protected by muscles, and in a fall upon the foot the strain comes more severely upon this than on the other. It may be broken near the knee, and sometimes the fracture opens into the joint.

A fracture in the upper part of either bone is generally caused by a direct blow and is crosswise. A fracture in the lower part is more likely to be the result of a fall on the foot, or a sudden twist of it and in this case it is more apt to be oblique. A common fracture is that called by surgeons "Pott's fracture," in which the outer bone is broken about three inches above the ankle, and if the force which breaks this bone is continued beyond *its* fracture—either the projecting point of the inner bone (the internal "malleolus," as it is called) of the tibia is broken, or the side ligament which serves to fasten this point to the heel-bone is ruptured, and in either case the sole of the foot is turned inward, with considerable deformity.

Symptoms.—When the limb is injured the first question is, whether it is a fracture or simply a bruise. The signs will differ according to the locality and character of the fracture. If only one of the bones is broken, there will be no separation or displacement of the fragments. The sound bone will hold them in place. Sometimes when the fracture is transverse (as frequently results from a direct blow), the patient may even be able to walk. If it is the inner bone that is broken the crack may be found by feeling along the shin soon after the injury has occurred. The grating between the fragments may also be recognized. Except at its ex-

tremities, the outer bone is deeply covered by muscles, so that a fracture near its centre is difficult to recognize. If both bones are broken all the ordinary signs of fracture will plainly appear.

Probabilities.—The bones will unite with proper treatment in about thirty days. If only one bone is broken the leg will probably be restored without any shortening or deformity. If the fracture is near the joint, there may remain more or less stiffness of this joint. Usually, however, this disappears in time. In "Pott's fracture," where the outer bone is broken near its lower end and the foot is turned outward, as shown in Fig. 288, by the fracture of the inner point of the tibia, or the rupture of the side ligament of the ankle, this displacement of the foot may remain permanent. If both bones are broken there will frequently be a shortening of the limb. Sometimes there will be a little curve to one side or forward or backward at the point of fracture. Sometimes an ulcer will remain for months or years over the point of fracture.

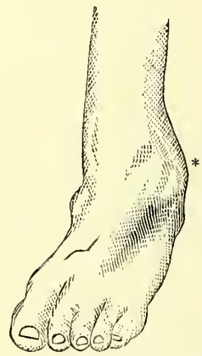


FIGURE 288. — "Pott's fracture" of the outer bone of the leg, with displacement outward of the astragalus (opposite the *).

In these fractures there is very likely to be an open wound, because the large bone lies so near the surface that a fragment is easily forced through. In this case the healing process is slow, and there is a liability to blood-poisoning from the wound.

Treatment.—The frequency and variety of fractures of the leg, below the knee, have given occasion for numerous devices in the way of splints and dressings. The object aimed at is chiefly to keep the limb quiet in a horizontal position, and to hold the fragments of bone firmly together. If only one bone is broken, there will probably be no shortening of the limb, and no occasion for any apparatus to draw the lower fragment down. When both bones are broken, shortening often occurs, and many surgeons attempt to counteract this by means of bands of adhesive plaster extending from the foot and leg below the fracture, to the foot-piece of the splint, and from the portion of the leg above the fracture to the upper end of the splint. A gaiter is sometimes put on the foot, the sole of which is connected with a foot-piece which is drawn down by means of a screw. The objections to these contrivances are forcibly stated by Dr. Hamilton. If the bandages or adhesive strips are put on with sufficient firmness to accomplish the object of extension and counter-extension, surrounding the limb as they must do in this case, there is danger that the blood-vessels will be com-

pressed and the limb injured or lost. If the bandages and adhesive plaster are simply applied lengthwise, so as not to constrict the leg, then, on account of the shortness of the surfaces above and below the fracture to which they are applied, there is not sufficient power over the limb to accomplish anything more than steadying it. If extension seems necessary, the double inclined plane is preferable, as by it the bandages or adhesive straps on the upper part of the leg can be dispensed with. The pressure of the thigh against the upper piece of the double inclined plane serves to hold the upper fragment against the force which is applied to draw down the lower one.

One of the simplest means of keeping the limb at rest is the fracture-box. This is a box large enough to contain the leg easily; long enough to extend from the knee to the sole of the foot, with the top and upper end open. The sides may be hinged to the bottom for greater convenience. In this box the leg may be covered and supported with bran in the following manner: Spread in the box a piece of cotton cloth a yard long and half a yard wide. Spread a layer of bran over that part of the cloth which covers the bottom of the box, moulding it so that it will fit closely to the back of the leg. Then lay the leg upon it, and fill in with bran at the sides and above until the leg is packed or covered.* Then the sides of the cloth are brought up over it, and fastened along the top of the leg, above the box. Thus the cloth makes a bag which encloses the bran and leg. If there are any wounds or sores they should be covered with salve and a rag. The bran will absorb matter that may be poured out, and the lumps, thus formed, may be picked out, leaving the rest dry. The fracture-box may also be padded with cotton, and the limb covered lightly with a roller-bandage. Or it may be suspended above the bed in a sort of cradle.

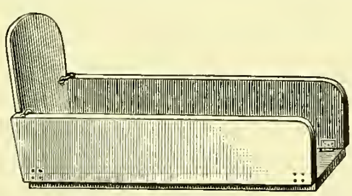


FIGURE. 289—A fracture-box.

Another capital dressing for a broken leg, especially if it be a compound fracture, is that of Dr. Hamilton. The limb is first encased in plaster-of-Paris applied upon roller-bandages, as hereafter directed, after being covered with cotton wadding. A win-

* [Clean, dry sand may also be used in place of bran when there is not an open wound. It is less elastic than bran and keeps its place more securely. Slight movements of the limb will, in time, cause the sand to work under the limb, and gradually raise the latter to the surface, so that at intervals of a couple of days the packing should be renewed.—Ed.]

dow must be cut in the splint directly over the open wound, if one exists, and the edges of the window covered with oiled silk or thin rubber-cloth to protect it from the matter which exudes from the wound. The limb may then be suspended from the simple but efficient framework shown in the cut. The suspending bandages may be made broader than those represented, and in these the limb will swing with great comfort to the patient.

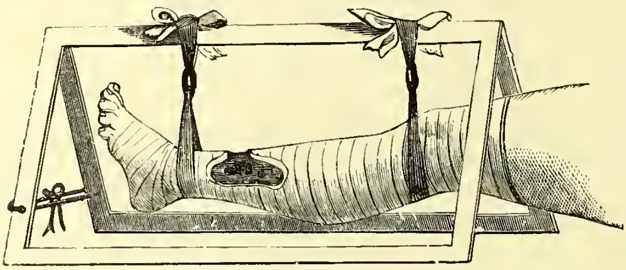


FIGURE 290.—Hamilton's method for suspending a "compound" fracture of the leg.

If only one bone is broken there will be little or no displacement of the fragments if the fracture is near the middle of the shaft, and it is sufficient to apply a straight wooden splint with a foot-piece to the *sound* side of the limb. This splint should be well padded, so as to fit the limb accurately, and be bound on with roller-bandages.

If the inner bone is broken near the knee, whether the fracture extends into the joint or not, put the limb into a fracture-box, well cushioned or filled with bran, and use cold or hot water upon the knee to reduce inflammation, if any exists. As soon as possible, without separating the bones—in four or five weeks usually—begin to move the joint a little every day, that it may not be left stiff. In "Pott's fracture," where the outer bone is broken a few inches above the ankle and the foot is turned out, there is usually much swelling, and it is difficult to make out the exact location of the fracture and still more difficult to set the bone. It may be necessary to keep the leg supported on a pillow, and apply cold for a time to reduce the inflammation before putting on a splint. The important point in the treatment of this fracture is to bend the foot in and keep it there. Dupuytren's splint, which is very commonly used for this purpose, is made in the following manner: make a pillow, stuffed with cotton batting, long enough to extend from the knee to the ankle, five or six inches wide, and two or three inches thicker at the lower than at the upper end. Of a strip of board make a straight splint, extending from a point four inches above the knee to a point three inches below the bottom of

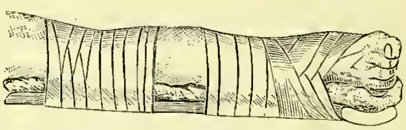


FIGURE 291.—A splint applied to the outside of a leg, for fracture of the inner bone.

the foot. Lay this pillow upon the splint, and the inner side of the leg on the pillow, arranging the latter so that it will fill in the space between the lower part of the leg and the splint. Then wind a roller-bandage about the knee and the upper end of the splint, and bind the foot to the splint in the same manner. *Be very careful,* in putting on the last bandage, *not to go higher than the outside ankle-bone.* The patient may then lie so that the splint on the inside of his leg will rest upon the bed, or the outside may rest upon a pillow if the patient changes his position to the other side.

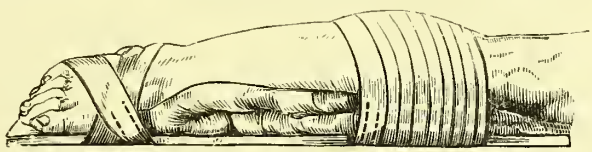


FIGURE 292.—Dupuytren's splint for fracture of the outer bone of the leg, near its lower end.

Another way of dressing this fracture is to put on a plaster-of-Paris dressing by some one of the methods to be described a little later, taking care that when the plaster is applied the foot is turned into the position in which we wish it to be kept. As a stiff ankle-joint frequently follows this fracture, it is important to remove the dressings as early as it can be done with safety (which is usually in three or four weeks), and to move the joint regularly to prevent this stiffness, if possible. An excellent splint may be made of wire-cloth, which may be moulded to the limb, well padded, and put on with straps or with strips of bandage. It is light and cool, and gives good support to the limb.

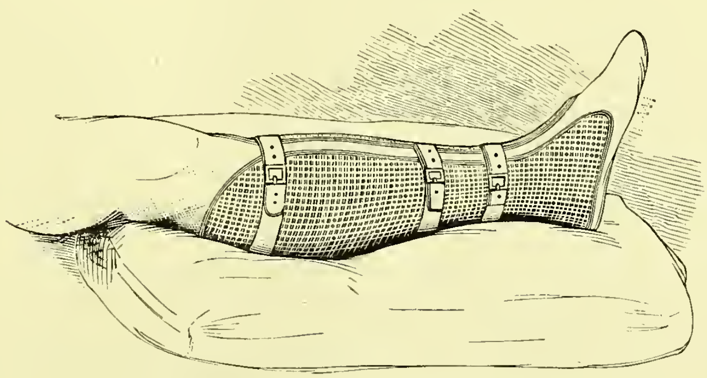


FIGURE 293.—Bauer's splint of wire-cloth for fracture of the leg.

Another light dressing, easily made, is the pasteboard and iron splint. Take a strip of pasteboard or binder's board as long as the limb and wide enough to half surround it, cut it to the shape of

the limb and then rivet a narrow strip of hoop-iron or tin along its centre from top to bottom, bending the iron in such a manner as to give shape to the splint and hold it firmly. The iron can be bent, as desired, to fit the ankle, and should be riveted to the outside of the pasteboard lengthwise. Then wet the pasteboard until it is soft and mould it to the limb, and when it dries it will form a light, firm and well-fitting splint, which should be padded, and be bound on with roller-bandages. One of these splints may be placed on each side of the limb.

The most useful and eligible dressing, on the whole, for fractures of the leg, is plaster-of-Paris in some of its various forms of application. There is a danger, however, in its use which should be carefully guarded against. The leg, below the knee, is far removed from the heart, the centre of circulation. At its upper and lower end, near the joints, there is but little flesh to cover and protect the blood-vessels, and the injury and swelling consequent upon these fractures is apt to be extensive and severe. Therefore, in putting on a tight or firm dressing of any kind, we are liable to compress the vessels too much and thus endanger the limb. When, however, the dressing can be carefully watched and *removed* at the first indication of danger, such as severe pain or discoloration of the toes, the usual means to subdue inflammation may be resorted to, and the plaster bandage may be put on again as soon as the swelling has somewhat abated.

In some cases we may apply the plaster-of-Paris immediately after the injury, especially if the fracture is seen before swelling occurs, and if there is little or no displacement of the broken bones. These remarks apply to the *immovable plaster dressing* which is applied as follows :

Prepare six or eight bandages, each three yards long and two and a half or three inches wide, of some coarse and loosely woven material, such as cheese-cloth, crinoline, or cheap sleazy cotton sheeting. Dust the plaster evenly over them and rub it into the meshes of the cloth, and roll them up as fast as the plaster is applied. Then cover the limb from knee to toes with cotton batting, or else take a strip of blanket wide enough to surround the limb ; fit it smoothly as possible over it and "catch" it together with a few coarse stitches. Soak the plastered rollers in warm water for three minutes, and then, beginning just above the toes, wind it smoothly over the cotton or blanket up to the knee. While applying one bandage have another soaking, so as to have no delay, or if the bandages are closely rolled, *two* should be put in at first, and then as one is removed from the water, replace it with a dry one. Three or four thicknesses of these will make a sufficiently firm

splint, which should be covered by another layer of dry unplastered roller over all. If the plaster is good (and it should always be tested before using, by mixing a little of it with water in a saucer to the consistency of cream) it will harden sufficiently in half an hour to retain its form, though it may be several hours before it is perfectly dry and hard. If a well-dried plaster cannot be

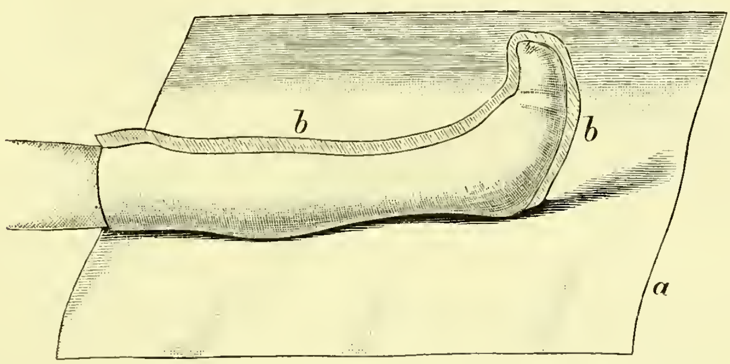


FIGURE 294.—The Bavarian splint for fracture of the leg: *a*, the outside layer of flannel; *b*, *b*, the inside layer sewed about the leg so as to leave a "roach" when its edges are trimmed.

obtained when required for use, a poorer quality may be made to harden quite rapidly and firmly by the addition of a large spoonful of the *sulphate of potash* to the three quarts of water in which the rollers are soaked. This, however, renders the cast more brittle and likely to crumble if moved while drying.

An excellent form of plaster dressing is the Bavarian splint for the leg, so called because used in the Bavarian army during the Franco-German war. Its advantages are that, 1st. It is easily and quickly prepared and applied. 2d. It is open in front and has a seam in the back which acts as a hinge, so that it can be removed at once when necessary. To make this take some soft, thick, elastic material, of which the best

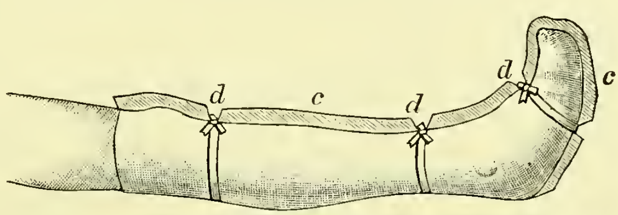


FIGURE 295.—The Bavarian splint: the outside layer has been applied and trimmed to fit the roach, *c*, *c*, and the whole has been tied together by means of tapes, notches having been cut in the roach.

is coarse house-flannel, or old army blanket—cotton should not be used when avoidable—cut two pieces as long as the part of the limbs you wish to cover, and wide enough to fold entirely around the limb, the outer or under fold being at least two inches the

wider. Lay one upon the other and sew two seams half an inch apart, through both pieces in the middle from top to bottom. Lay the limb on these seams, bring the edges of the inner piece together over the top of the limb and fasten them by a few coarse stitches, so that it will fit the limb smoothly and closely as a well-fitting stocking, and trim off the edges outside of this coarse seam. Mix the plaster with water to the consistency of thick cream or honey, and spread an even layer, not more than half an inch thick, over the outer piece of cloth, and then bring this outer piece over upon the one covering the limb, and while the edges are held firmly together by an assistant, smooth down any inequalities. You have thus two layers of cloth with plaster between, as shown in the illustration. When it dries, cut the stitches in front and the hinge at the back will allow it to be opened widely. It can be fastened on with a roller-bandage, or with strips of cloth or tape.

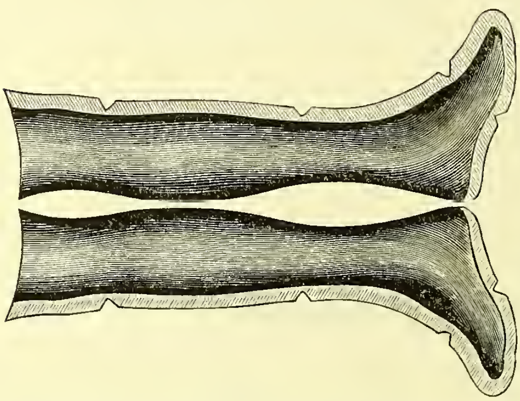


FIGURE 296.—Appearance of the Bavarian splint as it is removed from the leg and opened out.

In applying the plastered rollers cover the foot well in, but leave the toes exposed, and if these retain a healthy and natural appearance, and are not discolored, nor too hot, nor too cold, the plaster case may be left undisturbed for several days if there is no open wound which requires attention. In a day or two the patient may even get upon crutches, being careful to bear no weight upon the injured limb.

In a week or thereabouts, or when the splint becomes loosened from the natural shrinkage of the leg, the plaster case may be opened by placing the patient upon his back, and, beginning at the top of the splint under the centre of the knee-cap, cut down the middle of the front of the leg to the toes. The cotton batting underneath protects the skin from injury during this process. The best tools with which to open a plaster-of-Paris splint are a short saw with a framed back, such as is used by carpenters in squaring their work, and an old razor. Either one will answer the purpose admirably, but a common knife, if sharp, can be used. The splint can now be sprung off the leg, the cotton bat-

ting removed, and be replaced by a smooth cotton cloth lining fastened to the inside of the splint with starch. A short strip should now be cut from each edge of the splint to compensate for the removal of the batting, and make it fit more closely. It may now be sprung open again, the limb replaced, and secured by a roller-bandage, or strips tied over the shin and foot. The leg can now be examined at any time by merely springing open the splint without removing it.

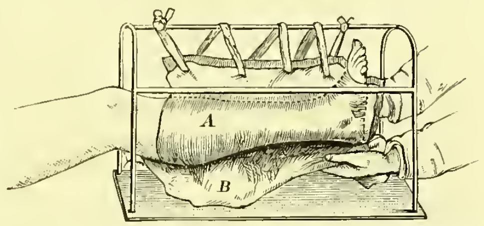


FIGURE 297.—Method of slinging a leg by the margin of the first layer of flannel, so as to facilitate the application of the second layer covered with wet plaster.

If there is an open wound in connection with the fracture, or a bruise upon the surface which needs dressing, the splint may be removed in the same manner, and a window may be cut out of it within two or three hours after its application, as shown on page 692 ; but in this case the cotton batting should not be removed, excepting that which is over the wound, until any possible swelling has subsided, when it may all be taken away, and the splint trimmed and lined as above.

If the wound is very large, instead of applying the plaster in this way, a piece of blanket or old flannel, long enough to reach from the knee to the ankle, may be folded until it is two or three inches wide and one-half an inch thick, which should then be dipped in plaster previously mixed with water to the consistence of cream, and this may be laid along that part of the leg opposite to the wound. Plaster bandages may then be wound around the limb and over this strip of blanket, above and below the wound. The plaster in the old flannel will become hard, and thus it will serve as a longitudinal splint, fitting the limb accurately. A simple frame, like that devised by Hamilton to suspend the limb (see page 692), will give ease to the patient, allowing greater freedom of movement and keeping the bed-clothing from the limb. When the limb is not suspended, a rack of arched wires should be used to sustain the weight of the bed-clothes. Or a very simple rack can be made out of an ordinary wooden hoop, such as are used upon flour-barrels. Cut the hoop in halves, cross the middles of the halves at a little less than a right angle, and fasten them together, then nail to the ends of each half two bits of board. One of these bed-pieces being placed on each side of the injured leg, the crossed hoop will make a strong arch on which the clothing may rest.

After the plaster bandages have been applied, the surface may

be smoothed by dipping the hand or a brush in a solution of plaster, and spreading it evenly over all.

Another method for making a removable splint is described by Dr. Van Wackenhagen, of Brooklyn : Take a woollen or cotton stocking which will fit the foot of the patient, and long enough to reach to the knee. Lay it flat on a board, and cut out from a piece of coarse flannel six pieces of the same shape as the flattened stocking, only cut them one-quarter of an inch larger every way, to allow for shrinkage. Soak the layers of flannel in water and press them dry. Then take a cord one-fourth of an inch in diameter, and sew it to the middle line of the stocking behind, from the top to the toe, carrying it over the heel. Cut the stocking down the middle line in front, put it upon the injured limb and stitch or lace it from the toe to the top. Then, having soaked the flannel pieces in plaster and water as thick as cream, apply them, three on each side, to the stocking, being careful not to cover the middle line in front or behind. Spread a thin layer of plaster smoothly over the surface, and allow the whole to dry thoroughly. A coating of shellac varnish over all will add to its elegance and firmness.

To take it off, start at one end, on the back, and cut the stitches which fasten the cord to the stocking, and remove it. Then, with scissors the stocking can be easily cut open. The stitches in the middle line in front can then be cut, and the whole will come off in two pieces. These can then be bound on again with roller-bandages, or tied together with broad tapes over the shin, and thus avoid the necessity of moving the broken limb. If long stockings cannot be obtained, eight layers of flannel may be shaped as accurately as possible to the limb, and the first layer may be put on dry, and stitched or laced up and down the front and back, and then, the limb being held in position with the bones set, the other layers can be soaked in plaster and applied. It must, however, be remembered that extension and counter-extension must be kept up until the plaster is firm and solid, in all cases where there is any displacement.

Glue can be used for a similar dressing. It has the advantage over plaster of being elastic. A long stocking may be split down the front and put upon the leg and sewed up. Side pieces, cut after the pattern of the stocking, may be soaked in melted glue and applied, and when dry the dressing may be removed by opening the stocking down the front and bending it open. The back of the stocking acts as an elastic hinge, and it will spring back into shape so that it can be replaced without cutting down the back. Starch

may also be used instead of plaster in several of the dressings just enumerated.

If the fracture is a compound one—that is, if there is an open wound connecting with it, there may be a good deal of bleeding. This should be checked by raising the limb, by applying cold in the form of ice or water, or by tying the divided arteries, where this is necessary and possible. In the lower part of the leg the arteries can easily be found and tied. In the upper part they lie very deep, and it may be impossible for a non-professional person to reach them in the bruised and torn flesh, and in some cases even a surgeon fails to tie the artery without cutting above the wound. In case the bleeding is not stopped by the means above referred to, and those to be found on page 590, it may be necessary to amputate the limb as soon as possible. After the bleeding stops, the wound should be thoroughly cleansed of clots of blood, dirt, or whatever foreign matter may be present. Loose pieces of bone should be carefully removed, using pointed scissors to sever any slight attachments to the main bones or to the soft parts. If the edges can easily be brought together and the parts are not greatly bruised, the wound may be closed up tightly and covered with adhesive plaster. But where there is much destruction of the flesh, and if it is difficult to close the wound, it must be treated as an open wound with water dressings and poultices, and allowed to heal from the bottom. The leg should be put up in a dressing which leaves the wound uncovered.

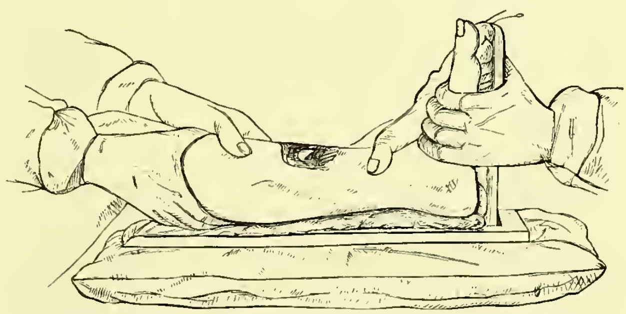


FIGURE 298.—Showing the mode of adjusting the leg to a back-splint and foot-piece, in a case of compound fracture, previous to the application of bandages.

Occasionally the bones will fail to unite, and should be treated by the methods recommended for ununited fractures of the thigh. Sometimes they unite at such an angle that it is desirable that they should be broken again (the patient being placed under the influence of ether) and the bone reset. But this, as heretofore stated, should only be attempted by a competent surgeon.

Fracture of the Bones of the Foot.

The skeleton of the foot consists of several small irregular bones forming the ankle and instep, a larger bone forming the heel, and the long bones forming the flat of the foot and the toes. (See page 26.) The bones of the heel and the ankle are sometimes broken by a fall in which the weight of the body comes upon the bottom of the foot. The other bones are seldom broken except by severe and unusual crushing force, as a blow from a heavy body or the passage of a wheel over them.

Symptoms.—A fracture of the bones of the ankle or instep is not easy to make out. There is usually much swelling, and very little, if any, displacement of the fragments. But it is not a matter of practical importance to make an accurate diagnosis here. If the large bone of the heel, or either of the bones of the flat of the foot or the toes, is broken. we shall probably be able to perceive the grating between the fragments, and may feel an irregularity of outline.

Probabilities.—It will usually be some months before a broken foot will be sufficiently restored to enable the patient to walk without limping. Permanently stiff joints may be the result. Of course the prospects of recovery will depend largely upon the amount of injury done to the flesh and the ligaments. If this be slight, the bones will unite rapidly, and very probably without deformity.

Treatment.—In simple fracture of the ankle or instep-bone, all that is necessary is to put the foot in an easy position upon a pillow and reduce the inflammation by cold or hot water. If the heel-bone is broken, the powerful muscle of the calf, which is inserted into it, will draw up its fragment and keep it separated from the other. It is important, therefore, to relax this muscle. For this purpose the knee should be bent and the foot straightened to bring the heel as high up as possible. A wooden splint should be laid along the front of the leg and ankle, and a roller bandage should be wound over it, with pads to keep the bones in place. A splint of leather or tin will answer the purpose. Bear in mind that it is only necessary to apply some splint to the front of the leg and top of the foot which will bind the foot as far down as possible and keep it fixed in that position. Plaster-of-Paris may be made very useful here. After putting the leg in position it may be fixed and held firmly in a solid plaster casing. The ankle and leg should be first padded and then covered with a roller-bandage, and the plaster bandages applied over this. Another method is to

put a firmly stuffed collar around the leg, just above the knee, and fasten it to the heel of a slipper by a tape.

In simple fracture of the bones of the flat of the foot or of the toes, if the fragments are not displaced, it will only be necessary to keep them quiet without any dressing. If the fragments are displaced, they must be set, because a prominence of bone in any part of the foot will cause pain and lameness. Sometimes it may be necessary to cut out a projecting point which cannot be forced into proper position, but this, too, can be done only by a surgeon. Splints of light wood or pasteboard (if any are necessary) should be applied. These should generally be broad enough to cover the whole sole of the foot. When a toe only is broken, a small splint of tin, wood, gutta-percha, leather, or pasteboard may be put on if preferred to a broad one. If there is an open wound communicating with the fracture, the loose fragments of bone should be removed, the wound cleaned, and the foot be saved if possible. In case the wound is extensive, the main point is to treat it promptly, and if possible, allay the inflammation and encourage the healing process. (See section on "**Wounds,**" page 597.) The fracture is of secondary importance compared with the other injuries. Inflammation and death of the bones may make it necessary that a surgeon should remove some of them before the wound will heal.

Injuries of the Head.

This class of injuries embraces concussion of the brain and fracture of the skull; either of which may result in compression of the brain, or, as a result of concussion, the brain-substance may be bruised. These accidents may result from blows or falls upon the skull, or falls from a considerable height upon the end of the spine or the feet.

Concussion of the brain may be so slight in degree as to cause only momentary confusion of ideas, as when a blow or fall on the head causes the person to "see stars," as it is said, and be giddy for a few moments. In more severe cases, unconsciousness may remain for several minutes and be accompanied with pinched and cold features; feeble and irregular pulse; slow and difficult breathing; involuntary escape of fæces; fixed pupils; and, following the recovery of consciousness, there may be for several hours some confusion of ideas, and a feeling of discomfort about the head. As consciousness returns, the slow and difficult respirations become irregular and sighing, and the patient is apt to become, for a time, delirious or to talk without sense. Children, while recovering from concussion of the brain, sometimes have a convulsion.

If the force has been sufficiently great to cause a bruise of the brain-substance, consciousness may be longer in returning, if it does so at all, and accidents of this sort are very likely to be fatal. Occasionally a blood-vessel is torn, and the escape of blood either into the space between the brain and the skull, or into the cavities of the brain itself, causes symptoms of *compression* of the brain closely resembling those due to concussion, and is pretty sure to cause death.

Persons having diseased kidneys, and those whose blood-vessels are in a condition predisposing them to apoplexy, are most likely to suffer fatal injury from comparatively slight blows upon the head, while others who have a strong predisposition to insanity or other nervous diseases, or who are accustomed to use liquor in excess, are liable to become insane shortly after suffering from a concussion of the brain.

Blows and falls upon the head may also cause fracture of the skull. This may take place either at the point where the blow is received, or at the base of the skull, or both. Children, in whom the bones of the skull are tough and elastic, are somewhat more liable than adults to fractures of the floor of the skull by blows received upon the crown of the head.

A simple fracture of the bones, unaccompanied with injury to the brain or the membranes covering it, and in which the fragments are not pressed inward, is, ordinarily, of no greater importance than a simple fracture of any other bone, but in reality such simple fractures seldom occur, and when a skull is broken, we find either that blood-vessels have been torn and blood has accumulated so as to cause compression of the brain, or the fragments of skull themselves remain depressed below their natural surface and cause such compression.

There are few surgical emergencies which demand such skilful judgment in their management as injuries of this kind, and no delay should be allowed in sending for a surgeon. To illustrate the difficulties which such cases may present, let us suppose that an unknown person is found by the road-side in a state of unconsciousness, with a wound of the scalp and with an odor of liquor about the breath. He may have been overcome with liquor and fallen and cut his scalp, and his stupor may be from intoxication; or he may have been struck on the head by another person, or fallen accidentally and be suffering from concussion, and the liquor he had been drinking may have no direct connection with his present condition. Again, he may have a fracture of the skull beneath the wound or in the floor of the skull and be suffering from compression of the brain, or he may have had an attack of apoplexy,

and in falling, cut his scalp; or he may have had an epileptic convulsion and received his scalp injury, and, perhaps, a fracture as he fell. A running horse may have thrown him from a wagon, and, without his having any scalp wound whatever, he may have suffered a fracture at the base of his skull from having struck on his head as he fell. There are yet other contingencies, but the above will show the need for caution and the difficulty which may attend the recognition of the true condition of affairs. It may be mentioned, however, that when the face of the person is dusky and his lips livid, when the breathing is deep and snoring, and if frothy saliva tinged with blood comes from the mouth, and if an examination of the cut on his scalp shows no fracture of the bone, it is probable that the case is one of epilepsy. When there is an escape of blood from the ears, or to any considerable extent from the mouth, or when blood can be seen under the *conjunctiva* or mucous membrane covering the white of the eye, it is probable that the floor of the skull has been fractured.

Treatment.—When a fall or blow has resulted in only temporary loss of consciousness, the person should nevertheless go to a quiet place, and be kept at rest for some hours. At the same time he may take a dose of bromide of potassium, sodium, or ammonium, and repeat it in two hours—say thirty to forty grains for an adult, or ten grains for a child of six to eight years. It may be well to give, also, a Seidlitz powder, solution of citrate of magnesia, or Rochelle salt, and await the arrival of a physician.

If the duration of unconsciousness is greater, the person should be *carried* to the nearest place, where he can be made quiet. Without unnecessary trouble in removing clothing, he should be laid on a bed or lounge in a darkened room, with the head raised on pillows. Bottles of hot water, or hot bricks or blankets should be placed around him to restore heat to the surface. If by a loud voice he can be aroused to consciousness, so as to swallow, a dose of forty grains of bromide of potassium (for an adult) dissolved in cold water may be given, and cloths frequently wet with iced water may be put on the head. The fumes of ammonia or hartshorn, or of camphor may be inhaled sparingly; but on no account, without the advice of a physician, should alcoholic stimulants be given, as they are liable to cause too great a reaction, and set up inflammation of the brain or its membranes.

When there is a wound of the scalp, it may be easy to detect by feeling with the end of a finger, whether the bone beneath is fractured; or, if a fracture with depressed bones exists, it may be apparent to the eye. If no physician is at hand, and there is likely to be a considerable delay in securing one, an intelligent

by-stander may undertake to raise the depressed bones into place with a pair of forceps or pincers, or even by means of a hook made of a piece of bent wire or a hair-pin. Unless, however, the bone is crushed into fragments, such an attempt is not likely to be very successful without the aid of instruments, which are not likely to be at hand in domestic practice.

To accomplish replacement of the bones surgeons resort to the use of a lever, and occasionally, in order to have a space in which to operate, it becomes necessary to use an instrument called a *trephine*, having saw-teeth on its edge, and working like a tool used in cutting axle-washers, or like a centre-bit.

The point in the centre of the instrument is first made to project, and is placed on the firm edge of the skull. After the teeth

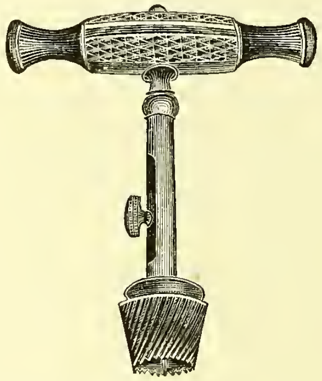


Fig. 299.

Fig. 300.

Figure 299.—A trephine.
Figure 300.—A lever for raising depressed fragments of skull.

of the instrument have cut a groove sufficiently deep to hold it in place, the point is then withdrawn into the handle, and the cutting is then carefully continued until the bone is perforated. The lever is then used to remove the button of bone, and then being inserted into the opening the fragments can be raised into place. —Ed.]

INJURIES OF THE JOINTS.

Dislocations—General Considerations.

In order to give the reader a clear idea of the injuries that may affect the joints from violence of any kind, it is necessary, first, to consider the structure of the different joints of the body, in order that we may treat the injury properly, and not increase the difficulty by unskilful manipulation.

All the bones of the body are connected, and these connections are joints. These are of two kinds—the *movable* and *immovable* joints. The movable joints are those most commonly dislocated, while the immovable articulations, which are chiefly between the bones forming the face and skull, are very rarely forced from their natural position unless fractured.

The *movable* joints are those which connect the skull and the spinal column ; the lower jaw with the skull ; the shoulder or upper arm with the shoulder-blade ; the shoulder-bone with the lower arm, constituting the elbow ; the lower arm with the hand, forming the wrist; the hand with the fingers and thumb, and the bones of these with each other. These joints all belong to what are called the upper extremities of the body, and are frequently dislocated. There are a few other dislocations that take place in this region, but so rarely do they occur that they need merely to be mentioned here. These are dislocations of the different bones of the spinal column; of the inner end of the collar-bone from the breast-bone; of the outer end from the projecting point of the shoulder-blade, and of the eight bones forming the wrist from each other. In the lower extremity we have dislocation of the head of the thigh-bone from the hip or haunch ; of the lower leg from the thigh at the knee ; the knee-pan from its position over the joint ; the leg from the foot at the ankle ; the bones forming the hinder part of the foot from each other, and the toes from the foot.

In order to understand how these dislocations occur, we must examine a little further into the structure of these various joints. The bones which unite to form the movable joints are generally larger at the ends than in the middle. This is for the better convenience of mutual connection, thus giving greater strength and freedom of motion to the joints. The ends of the bones are closely covered by a dense membrane, called *cartilage* or "gristle," which furnishes smooth bearings for the connecting bones ; while they are held together by a tough tissue, called *ligament*, which envelops them completely like a tight bag. This bag is called a

capsule, and is lined by a membrane which furnishes a fluid that lubricates the joint, and hence is called *joint-water* or *synovial* fluid. This capsule or bag is not sufficient in itself to hold the bones together, and hence the joint is strengthened by short bands of this same ligamentous substance, which pass from one bone to its fellows, covering the capsule. There are also ligaments within the capsules of the hip and knee-joints, which connect the ends of the bones directly with each other.

The "ball-and-socket" joints, such as the thigh or hip and shoulder, are also protected from dislocation by a rim of cartilage attached to and projecting beyond the edge of the cup-shaped cavity or socket, thus deepening the socket, and hugging the enclosed ball, viz., the head of the opposing bone. The joints are still further strengthened by the tendons of the muscles above and below the joints, a full description of which will be found in the chapter on Muscles. [See page 30.] Some of these tendons are united with the ligaments of the joints, while others, which are long and flattened, pass by and cover in the joints outside the short ligaments. This being the construction of the joints, a dislocation is *the displacement of one bone from another at its place of natural connection.* When entirely displaced, it is called *complete;* when not so, *partial* or *incomplete.* It is called *compound* when the dislocation is associated with an open wound communicating with the joint, and *complicated* when there is a fracture of bone or laceration of a blood-vessel in addition to the dislocation.

Dislocations are usually caused by violence, either direct or indirect, but they sometimes occur from spasm or muscular contraction. Of course dislocation by violence cannot take place without injury to the capsule, the short ligaments, tendons, and muscles which cover the joint, and these are sometimes torn to such an extent as to destroy the mobility of the joint, *i. e.*, make it stiff. The capsule splits to allow the dislocated end of the bone to escape, while the short ligaments are necessarily torn more or less. These structures, however, readily unite and heal when the dislocation is reduced. If a dislocated bone is never reduced or *set,* as it is called, Nature furnishes, in time, ligaments and a new socket for the displaced head of the bone in its new situation, and a very useful joint is often the result. Meanwhile the old socket is gradually filled up.

The ball-and-socket joints are especially liable to dislocation—the shoulder in particular—while the elbow, from its exposed situation, is oftener displaced than the hip.

Diagnosis, or how to Detect a Dislocation.

Dislocations are characterized by *immovability* of the limb, while fractures are directly the opposite, as the broken limb is very movable. A dislocated arm or leg is usually stiffly fixed in its unnatural position, and movement is difficult or impossible, while any attempt to move the limb by another person gives great pain, and is *not* accompanied by the grating sound (*crepitus*) which is heard when the ends of a *broken* bone are moved.

A dislocation is also indicated by more or less *deformity* of the parts, which can be detected by a comparison of the two sides of the body, viz.: the sound with the injured member. To accomplish this the patient should be stripped of all the clothing which covers the entire upper or lower extremities, as the case may be. Both limbs should be uncovered. The observer can then make out the direction the displaced bone has taken, whether *apparently* longer or shorter than its fellow, and drawn toward or from it. If the dislocated bone be drawn into its proper place it will remain, and any bunch or deformity will disappear, while if a fractured bone be treated in the same way, the distortion will usually return as soon as the limb is left alone.

The other signs of a dislocation are *pain*, *swelling*, and *discoloration*, and these also accompany a fracture, but are generally more severe in dislocations than in fractures, especially the pain when any attempt at motion is made.

To sum up, the important signs of dislocation are *deformity*, *loss of voluntary motion* to a greater or less extent, and *impaired motion* when made by another—the motion accompanied by great *pain* and tenderness. These signs apply to adults chiefly, as in children the heads of the long bones may be separated from the shafts of the same at the points of natural junction. These points are called *epiphyses*, and indicate the place of union of the heads of the long bones to their shafts when in process of formation. Separation of the head of a bone at this point is distinguished from dislocation by the fact that the separation is a form of fracture, and the grating sound is therefore present. Bruises and sprains may be mistaken for dislocations, and the loose joints of a paralyzed limb may give rise to the same error ; but the history of the case, and careful local examination, will lead us to a correct conclusion.

It should be noted here that the opening in the capsule made by the head of the dislocated bone is of variable size and shape. Sometimes it is a mere slit or tear, and sometimes it is an irregu-

lar triangle with ragged edges. The head of the bone, too, does not always remain at the point where it escapes from the ruptured capsule, but it may be higher, lower, or to one side, as the muscles attached to it draw and displace it. This renders it important to remember that we must often bring the head of the bone into a different position before we can carry it back through the opening in the capsule into its natural socket. This is accomplished by manipulation, as will be described hereafter.

General Treatment of Dislocations.

Before proceeding to consider *special* dislocations and their management, some general directions may be given which apply *to all* dislocations. The first thing to be done is to reduce the dislocation, or, in other words, to set the bone. The setting of a *broken* bone may be delayed, for various reasons, with propriety and safety; but there should be no delay in reducing a dislocation. This may be done in most cases, even without the use of ether, by extension or pulling with proper manipulation, if *the attempt is made immediately after the accident;* and in a large majority of cases the reduction may be accomplished by any intelligent person who will study the structure of the joints in the section in this work upon Anatomy [see page 28], and who will follow the directions to be given farther on. If the attention of the patient who suffers from a dislocation is fixed upon the person who is attempting his relief, and especially, as is most natural, if he is closely watching his proceedings, the muscles of the affected limb are in a state of contraction, and are therefore rigid, thus furnishing an additional obstacle to reduction. Now the muscles must be placed "off their guard" by diverting the attention of the patient. If, at that instant, when we move or pull the limb, a question be addressed to him, or a loud or sudden exclamation made, the muscles will relax for the time, and we may at once succeed in restoring the joint. The fact that strong contractions of the muscles occur in a dislocated limb, constitutes the main difficulty in setting the same, and gives to ether and chloroform their great value in cases of this kind, as complete relaxation of all the muscles follows the proper administration of either of these agents. No surgeon at this day would attempt to reduce a difficult or "ancient" dislocation without the use of an anæsthetic, and both ether and chloroform are used with safety in most cases. When, however, it becomes necessary for a non-professional person to resort to an anæsthetic, *ether should always be used*, if procurable, for if administered upon a sponge or a napkin, and not pushed too rapidly, it is perfectly

safe, and the unpleasant nausea which often follows is merely temporary. It should be inhaled until unconsciousness is complete, which may be tested by lifting an arm from the side and letting it fall. If it drops like a dead weight, the patient is ready for the operation; but if there is will-power enough left to arrest the arm after it leaves your hand, so that the patient holds it suspended in the air, then continue your administration till he responds to the test. Do not be afraid to push the ether as long as the breathing is regular and deep. When it becomes noisy and irregular your patient is ready for the operation. If the breathing should become feeble, or cease, suspend the ether, open the mouth of the patient, and, seizing the tongue with a napkin or handkerchief, draw it well forward, and at the same time press the chest forcibly and suddenly backward, while you direct some bystander to sprinkle the face or chest with *cold* water, throwing it on quite sharply. Another excellent method of restoring animation temporarily suspended by the action of ether (or especially chloroform) is to invert the natural position of the patient so that the head will be considerably lower than the body. This may be effected by suddenly pulling the head and shoulders off the bed so that the head will rest on the floor, or, if he be sitting, by tipping the chair backward upon the floor, raising the feet until he literally "stands upon his head," thus causing the blood to flow readily and rapidly to the brain. (This method is also valuable in cases of prolonged "fainting fits," or "syncope," as it is called). Should these means fail, as they probably will not, you can use the method described for the recovery of the drowned [see page 758.]. Where good ether is used, such accidents can never happen if the patient is in good health and the anæsthetic is properly administered.

"In no department of surgery is ether so valuable as in dislocations," says Dr. Bryant, "for where force once reigned, gentleness is now the rule; where difficulty and pain were common accompaniments, ease of reduction and painlessness now prevail." Whether ether is used or not, the limb should be handled gently and force applied judiciously. Under the old system of reduction by direct pulling or extension, aided by compound pulleys and other machinery, much mischief was done to the joints, and in one notable case in Paris a leg was actually torn from the body in this way.

Remember, first, to *manœuvre* in such a manner as to bring the displaced bone in such a position that the muscles may draw it into the socket. An assistant is always useful, and can aid the operator by holding the socket firmly fixed while you pull *steadily* until the resistance of the muscles is overcome. He can also, while

holding the socket with one hand, use the other to push or lift the head of the bone into its place at the instant when the tension of the muscles yields to your steady pull upon the limb.

After the dislocation is reduced the limb must be kept at rest until any tear in the ligaments, etc., may have healed. In some cases, as the knee, wrist, ankle, and elbow, the limb should be fixed in position by bandages, or even by a splint of pasteboard or leather.

If there is any swelling and pain following the reduction of a dislocation, the writer is in the habit of applying hot water by showering, or pouring in a continuous stream from any convenient vessel. This should be continued at least half an hour, and then the joint should be enveloped in bandages soaked in hot water. This showering may be repeated two or three times daily until the swelling and pain have subsided. If the hot water causes an *increase* of pain, it should be suspended and cool water used ; but this is the only exception to the use of the hot water, either in dislocations or sprains. The application of ice or cold water to a dislocated or sprained joint is almost universally practised, but any one who has seen the benefit of the hot douche in these cases will never resort to cold water unless forced to do so by the increasing pain. The main thing is to continue the showering or bathing long enough to attain the object desired. The shrunken and ridgy condition of a washerwoman's hand shows the effect of prolonged immersion in hot water, and this very constriction of the blood-vessels is what is required to keep blood from the part and thus prevent or relieve inflammation. In very severe cases where there is extensive laceration of the parts about a joint, and the swelling, heat, redness and pain are excessive, cloths wrung out in hot water alone, or in hot and cold water alternately, may be applied persistently for several hours. If the cold water gives more comfort than the hot, discard the latter and use pounded ice ; but be careful not to continue the application too long, as mortification of the limb might ensue. The effects of very cold water or pounded ice enclosed in a bladder or rubber bag should be carefully watched, and when the pain is relieved or when the patient complains of a benumbing sensation in the part, and the limb itself has become white and bloodless, the use of ice should be suspended at once. If ice is used the limb should be enveloped in flannel before the cold is applied. The best rule, however, for the application of cold is to use it at a temperature which will give to the patient the greatest degree of comfort. In most instances this will be about 60° Fahr.

Continuous irrigation, as it is called, by means of cold water dripped slowly but for a long time upon an inflamed joint, by means

of braided cotton-waste or lamp-wick hung from a vessel over the limb, is also of great benefit when it is desirable to reduce the heat of inflammation.

Three or four weeks must elapse before any *free* movement of the joint can be allowed ; but if there is little or no inflammation, the joint may be gently moved by another person, handling it carefully, at the end of two weeks. In dislocations of the hip, the patient should not be permitted to stand or walk for at least a month. If bandages or splints are applied, they should merely support the limb and keep it in one position, but little or no pressure should be made over the affected joint. Great care should be exercised for a long time after the limb is apparently well; for a bone once "out of joint" is apt to fly out again upon very slight provocation.

Particular Dislocations.

Dislocation of the Lower Jaw.

The lower jaw may be thrown out of joint upon one side only, or both sides may be out at the same time. The latter is the more common, occurring in two out of three cases. In this dislocation the rounded heads of the jaw are forced from their sockets in the skull. The nature of this accident cannot be mistaken, for when one side only is dislocated, the chin is turned obliquely, usually toward the sound side, whereas in fracture of the neck of the lower jaw the chin is turned toward the injured side. A depression will always be observed in front of the ear upon the injured side. Where both heads of the jaw are thrown out of joint, the mouth is open to its extreme width, the chin projecting and fixed, and the lips are widely parted, while speech is difficult or impossible. Saliva flows from the mouth freely, while there is a hollow in front of *each* ear, and above and in front of them a hard prominence or bunch. Fig. 301 shows the appearance of the face in dislocation of one side of the lower jaw. Fig. 302 shows the position of the jaw in a double dislocation. Fig. 303 gives the appearance of the bones themselves in a double dislocation, and is intended to show the bony prominence over which the heads of the bone must be forced backward into the socket.

FIGURE 301.—Dislocation of the left side of the jaw.

Cause.—Dislocation of the jaw is caused by violence applied in various ways, or it may be produced by muscular action alone. The attempt to force an apple into the mouth has produced disloca-

tion; extraction of teeth and digging out their roots; prolonged and violent vomiting and convulsions have also caused this accident; but the most common of all causes is yawning or gaping. In fact, fifteen out of twenty-five reported cases had this origin. A surgeon of Philadelphia treated a woman whose jaw was badly dislocated in consequence of the violent motion of that organ while scolding her husband, and one case is reported where this

FIGURE 302.—Appearance of the jaw when both sides are dislocated.

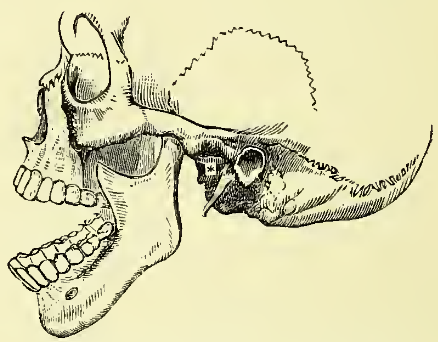


FIGURE 303.—The bones of the skull and jaw in a case of double dislocation of the former. The * is placed opposite the socket on the left side.

dislocation occurred from rage alone. The accident occurs oftener in women than in men, and usually between the ages of twenty and thirty. In infancy and old age it is of rare occurrence.

As in other dislocations, the displacement may be *partial* or *complete*. Sometimes it is accompanied by considerable pain, while at others it is merely annoying. When the jaw is not reduced or set, nature makes a partial cure, as in time saliva ceases to flow, and the jaws gradually come nearly, if not quite, together again; the power of speech and swallowing is restored; the patient learns to chew his food with comparative ease, and time brings about a very fair recovery. This trust in the "healing power of nature" is unnecessary, for no joint is more easily restored when the proper and very simple means are applied.

Treatment.—This dislocation may be reduced in two ways—the first of which is undoubtedly the best and simplest. The operator standing directly in front of the patient, and, after covering both thumbs with a thick glove or two or three folds of a napkin, should introduce one thumb upon each side of the jaw until they

rest upon the last lower teeth, while his fingers grasp the outside of the jaw firmly. Steady pressure must then be made upon the teeth downward and backward, while the chin is slightly lifted with the fingers that are *toward* the operator, viz., the little and ring fingers; this depresses the heads of the bone so that they readily slide over the prominences shown in Fig. 303. It is necessary to protect the thumbs, as the sudden closing of the mouth by the irritated muscles, when the bone slips into place, might cause the operator to become in turn a patient complaining of badly bitten or bruised thumbs. The accompanying cut, Fig. 304, illustrates this method admirably.

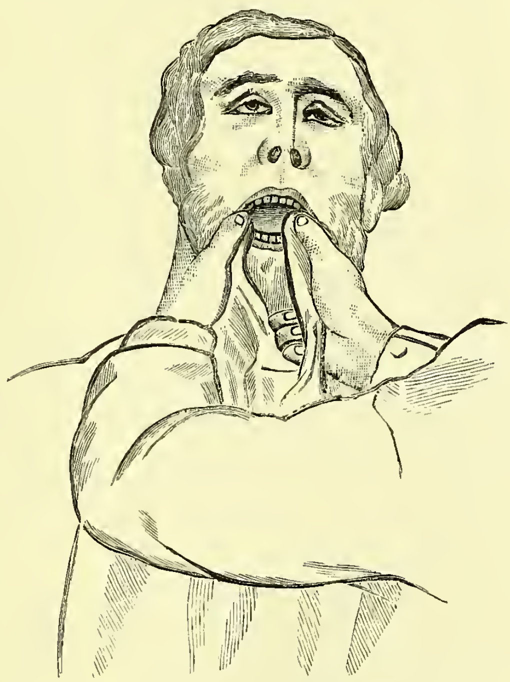


FIGURE 304.—Mode of restoring a dislocated jaw to its place.

The second method of reduction is for the patient to sit upon the floor, with his head between the knees of the operator. A couple of pieces of cork or soft wood are placed as far backward as possible, and between the last teeth in the upper and lower jaws, one upon each side. These bits of wood, or cork (which is preferable) should be thick enough to just fill the spaces between the teeth in the two jaws. Then the operator should take the chin in one or both hands, and draw steadily upwards, being careful *not* to pull the chin forward at the same time. Both these methods are practised successfully, but the one first described is approved by a majority of surgeons. After the dislocation is reduced, the patient should exercise great caution for a long time, as this is one of the joints that, once forced out, flies out frequently.

FIGURE 305.—Bandage to be applied to a jaw after a displacement has been relieved.

Dislocations of the Spine.

By referring to page 14, the reader will see that the spine is made up of irregular rings of bone piled one upon another, the skull surmounting the whole. It will also be seen that the spinal column is divided into three portions, viz.: the neck or *cervical* portion, the back or *dorsal* portion, and the lower or *lumbar* portion. Now, the head may be dislocated from the first ring or *vertebra*, and different bones or *vertebræ* may be dislocated from each other. When dislocation occurs above the third or fourth ring of bone (counting from *above* downward), death always ensues very quickly, as the spinal marrow or spinal cord is pressed upon by the displaced bone, which is a very dangerous accident, and the fact that the nerves which control the act of breathing start from a point near the third ring renders death from its occurrence almost certain. Uncomplicated dislocations of the upper portion of the spine are more common than in the lower divisions, because there is more motion allowed between the bones of the neck than between those of the back and hips; hence, dislocations in the lower portion of the spine are usually accompanied by fractures. Where any paralysis follows dislocation of the upper or neck bones, death generally occurs in two or three days, whereas displacement of the bones below the neck, followed by paralysis, may not prove speedily fatal.

Symptoms.—If complete paralysis occurs after an injury to the spinal column, it is almost certain that the spinal marrow or cord has been injured by the pressure of a displaced vertebra. If the paralysis is only partial, it is probable that only a portion of the cord has been bruised or stretched. The paralysis always occurs below the point of injury. If, upon examining the naked back, we see or feel any unnatural inequality or prominence in a particular spot, and if this is the seat of pain which is increased by pressure; if there is a grating or *crepitus* when the spine is moved; if there is puffing and discoloration about this spot, the bunch being apparently filled with an enclosed fluid; and finally, if there is any loss of motion below this point, with inability to support the body in a natural position, then we may safely conclude there is displacement or fracture of one or more of the bones of the spine, when we also learn that an accident has occurred to the patient shortly before the appearance of these symptoms. These signs may not all be present in any given case, but if there has been a dislocation or a fracture, one or more will certainly be found.

Probabilities or Prognosis.—The higher up the spine is injured, the greater is the danger to life. Although men have lived for

years when a displacement occurred in the neck, the entire body and limbs have become paralyzed, the act of breathing being sustained by regular contractions of the midriff. Where the injury to the cord is lower down, the patient dies, after years of suffering, from disease of the kidneys or bladder, or from bedsores—all caused by loss of nerve-power in the paralyzed part. Careful nursing often postpones the end and maintains life for a long time. Even if there is little or no paralysis, inflammation may ensue in the injured parts and prove fatal. The lower the seat of injury the better the prospect of recovery, and the chance of life is improved the less the cord itself is bruised.

Treatment.—The rules governing the treatment of these injuries are few and simple. Absolute and motionless rest is indispensable, and this should be in the horizontal position, upon a firm, smooth and even bed, which should be protected by rubber-cloth from the involuntary discharges from the patient. As a rule, no motion is allowable; but if there is evidence of great pain, or if much deformity is present, the head or shoulders may be gently and carefully pulled upward, while an assistant as carefully pulls the legs downward. A very little of the gentlest manipulation may be allowed, moving the neck or body from side to side, while the

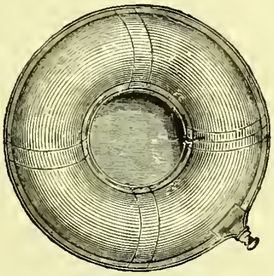


FIGURE 306.—An india-rubber ring-cushion with a bottom which enables it to be used also as a bed-pan.

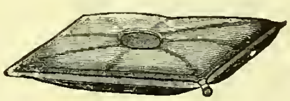


FIGURE 307.—An india-rubber air-cushion without a bed-pan attachment.

pulling or *extension* is kept up. Many instances are recorded where this method has given great relief, and the writer was once successful, by pulling the head gently upward, in the case of a man whose head was drawn backward and turned to one side. The accident in this case was caused by falling from the top of a load of furniture, and the patient had been totally unconscious for four hours, breathing irregularly and noisily. The bones came into place with an audible snap, and the man was restored at once, swearing at the horse he supposed he was still driving.

Great care is essential in looking after the patient: the state of

the bladder should be looked to often, and if the urine is not passed it should be drawn with a catheter, as described elsewhere in this work, remembering to use always an elastic or soft rubber catheter rather than a metallic one. The bowels should be kept open with a daily injection, if necessary, instead of giving cathartics by the mouth. The back and hips should be examined daily to guard against bedsores, and the spots where they seem likely to appear may rest upon the open centres of ring-cushions, which are easily made by constructing a tube of cotton cloth from one to two inches in width, which is to be stuffed with horse-hair, cotton, wool, or moss, and then the ends of the tube sewed together.

In turning the patient upon his side, be sure to turn the shoulders and hips at the same time, and thus prevent all motion of the spine. To do this well requires two persons. In short, by the exercise of unremitting care and watchfulness the patient's life may be prolonged indefinitely, and in some cases a recovery may reward the efforts.

Dislocations of the Shoulder-blade or Scapula.

By referring to the anatomy of the shoulder (page 10), it will be seen that the outer end of the collar-bone, or *clavicle* is joined to a projection upon the top of the shoulder-blade, called the *acromion process*. The separation of these two points has usually been called a dislocation of the outer or acromial end of the collar-bone, but as the latter is a fixed point, Bryant prefers to call it a dislocation of the shoulder-blade. In most cases this point of the shoulder-blade is forced under the outer end of the collar-bone (see Fig. 308,*), but the latter is sometimes found uppermost. This displacement is commonly the result of direct violence, as a blow from above, a fall from a carriage, or any elevation, upon the top of the shoulder. The detection of this injury is very easy as there is a hard and rather sharp bunch or projection upward of the point of the shoulder-blade in the one case, and of the outer end of the collar-bone in the other. Placing the finger upon the inner end of the collar-bone and tracing it outward will show at once if the outer end is above or below the shoulder-blade.

FIGURE 308.—A dislocation of the left collar-bone from the shoulder-blade at the point marked *.

Treatment.—Bryant gives the simplest rules for the replacing this dislocation, viz.: when the outer end of the collar-bone is above the point of the shoulder-blade, a pad composed of several thicknesses of soft cotton cloth should be placed over the dislocated end of the collar-bone, the arm bent to a right angle and then raised so as to elevate the shoulder; then a belt is to be placed over the pad to depress the collar-bone, and carried over the elbow to keep the shoulder elevated, and thence around the body to secure it in place. Or a long strip of sticking-plaster may be attached to the chest in front, carried over the pad, drawn firmly and attached to the back. The arm can be supported in a sling carried over the sound shoulder and be held to the side by a bandage adjusted around the body. In many cases of dislocated clavicle the bones will assume their natural relations when the patient lies down. When this happens, two or three weeks upon the back in bed is the best possible treatment.

Dislocations of the Head of the Shoulder or Humerus.

Dislocations of the head of the upper arm-bone are the most common of all dislocations, being more frequent than all the other dislocations together, which is easily accounted for by the shallowness of the cup or socket (the *glenoid cavity*, in which the rounded end of the bone rests); by the exposed position of the joint, and by the very extensive motion it enjoys in all directions. It is not as common in women as in men, simply because they are less exposed to accident; and it is caused by both direct and indirect violence, as blows or falls upon the shoulder, or falls in which the weight of the body comes upon the extended hand and arm. Direct draft or extension is another cause, as in driving a hard-mouthed horse or lifting a heavy weight. In childhood it is seldom seen, while it is rare up to the age of twenty-five. After this age the liability increases, until we find that the greatest number of cases occur between the ages of forty and sixty. It is not often met with in persons over seventy. As before remarked, this is the joint which, once dislocated, is liable to a recurrence of the accident from very slight causes.

Surgeons make four principal forms of this displacement, characterized by the position of the head of the bone when forced from its socket. While they admit that other forms have occurred, they are so rare that the rules for the detection and treatment of the four will guide the operator in his management of all. By referring to the anatomy of the bones (page 21), the reader will see that under the point of the shoulder, or *acromion process*, and out-

side of the socket of the shoulder-joint, there is another bony projection, which is called the *coracoid process*—so named from its fancied resemblance to a crow's beak. Now, in the first form of the dislocation the head of the bone is thrown inward and forward under this coracoid process, resting, usually, upon the inner lip of the socket. This is called the *sub-coracoid* or "under the crow's beak" dislocation, the head of the bone forming a hard bunch inside the point of the shoulder, as seen in Figure 309.

The second form is the *sub-glenoid* variety, and is usually called

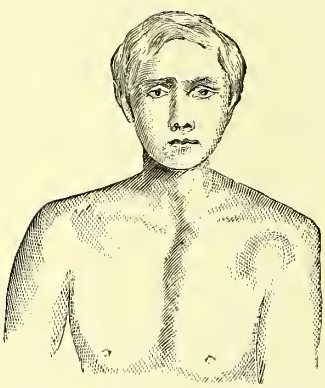


FIGURE 309.—A sub-coracoid dislocation of the left shoulder.

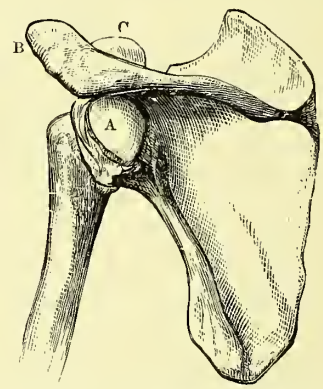


FIGURE 310.—A sub-spinous dislocation of the left shoulder: A, the head of the arm-bone; B, acromion process; C, coracoid process.

the "axillary" or "arm-pit" dislocation, in which the head of the bone lies in the arm-pit, producing the deformity seen in Figure 311.

In the third form the head of the bone is driven backward upon the shoulder-blade, where it rests under the base of the *acromion process;* or, if more complete, it rests under the bony ridge upon the outside of the shoulder-blade, and which is called the spine of the scapula. Hence, this form is called the *sub-spinous* dislocation.

The fourth form is the *sub-clavicular*, or "under-the-collar-bone" dislocation, because the head of the bone is thrown forward and inward, and drawn upward by the muscles until it usually rests against the second rib, and directly under the inner end of the outer third of the collar-bone. This dislocation is the rarest of the four, and is seldom seen.

All these dislocations are modified by the amount of tearing and injury which occurs to the muscles and ligaments about the joints, the head of the bone being carried farther out of place if there is great laceration than if the ligaments are merely

stretched and bruised, and the ease or difficulty of reduction depends chiefly upon this fact.

Symptoms.—All these dislocations are characterized by pain in the shoulder and arm, a benumbing sensation in the fingers, and inability to move the arm without aggravating the pain. In most cases it is impossible for the patient to touch the opposite shoulder with the hand of the injured limb. There is always deformity about the joint, the point of the shoulder projects with great sharpness, while a marked hollow can be felt immediately below it. In the first or *subcoracoid* form, and the fourth or *sub-clavicular* form, the head of the bone may be seen and felt in its unnatural position, and, by seizing the elbow and moving or rotating the arm slightly, motion of the head of the bone will be distinctly seen. In both these forms there will be little or no lengthening of the arm, but the elbow will generally project more or less from the side, while the motions of the forearm will be perfect.

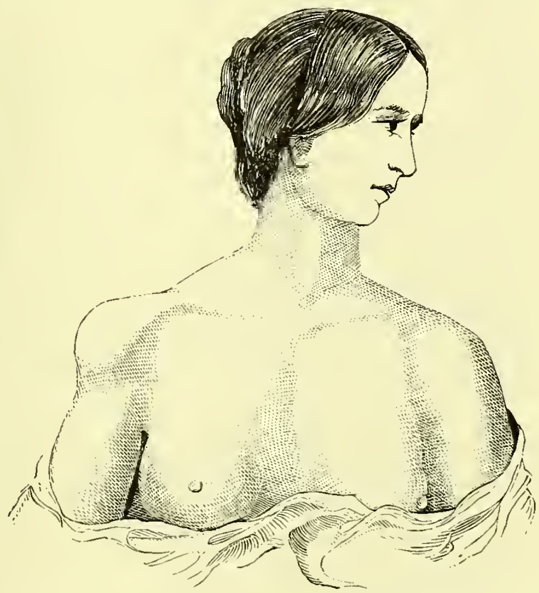


FIGURE 311.—Sub-glenoid dislocation of the right shoulder.

The second form, or dislocation of the head of the bone *downward* into the arm-pit, is recognized : by the lengthening of the arm ; by the hollow which is felt under the point of the shoulder, where the head of the bone ought to be ; by the flattening of the shoulder ; the elbow standing out from the side and not touching the ribs, while the head of the bone is felt in the arm-pit if the limb is raised. Moreover, the attempt to raise the arm causes great pain. The deformity is well shown in the foregoing cut. (Fig. 311.) In this dislocation the point of the shoulder is more sharply prominent than in the first form described, while the head of the displaced bone rests about two inches from the bony prominence called the *coracoid process*, which was described in the history of the first form of shoulder-displacements. Remember that in the first form the head of the bone is thrown *forward* and

almost touches this projection, while in the second it is forced *downward* and is *widely separated* from it.

The third or *subspinous* form is readily detected, as the head of the bone, being driven downward and resting upon the outside of the shoulder-blade, there is much more flattening, or even a depression in front of the shoulder, just under the acromion and coracoid processes, while the elbow will be drawn to the side and a little forward. Observation of the back part of the shoulder shows the head of the bone in its unnatural position.

An English surgeon has given what he calls an infallible mode of detecting dislocations of this kind. He suggests a measurement of the injured shoulder by passing a tape-line around the top of the shoulder, of course passing it through the arm-pit, as though he was measuring for a tight-fitting sleeve at that point. He asserts that there will be found an increase of two inches over the sound side.

The most common forms of this dislocation are the two first, viz.: the *subcoracoid* and the *axillary*, while the third or *subspinous* is rarest of all. The writer's experience shows that the second form (downward into the arm-pit) is the most common.

There are three fractures of these bones liable to be mistaken for dislocations, viz.: fracture of the acromion process; of the neck of the shoulder-blade, and of the neck of the arm-bone or humerus, just below the socket. The first two may be readily known by the ease with which the form of the joint is restored by lifting the elbow directly upward, while the deformity will return when the arm is dropped. *Crepitus* or grating sound may also be detected in the second form of fracture, while in the last, in which the neck of the arm-bone is broken, the arm will be shortened instead of lengthened; there is not so large a cavity under the acromion, and the rough, broken end of the shaft of the bone may be felt in the arm-pit instead of the smooth head of the bone.

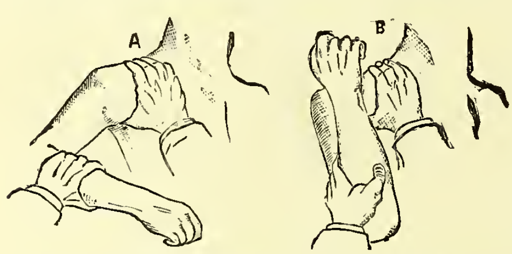


FIGURE 312.—Replacement of a dislocated shoulder by manipulation.

Treatment.—There are several methods of reducing this dislocation, all of which are practised with success. The older surgeons assert that by holding the shoulder firmly with one hand, and with the other depressing the elbow, the bone may be set *if the muscles can be taken off their guard*, and Bryant says that the same can be said of the modern method by manipulation. If the accident be recent, and no swelling or irritation of the muscles has occurred,

reduction by manipulation can be effected without the use of ether or chloroform, in the following manner: the shoulder (if it is the right one) should be grasped with the operator's right hand, while his left hand should seize the forearm below the bent elbow, as in the figure. When the head of the bone lies under the coracoid process, or under the socket, the thumb should be pressed against the head of the bone, and the fingers over the ridge or spine of the shoulder-blade, the thumb furnishing the point of resistance. With the other hand the operator draws the elbow from the side, at the same time pulling upon it and making a rolling motion outward; when the extension or pulling has been carried as far as possible, the elbow should be suddenly raised, and then as quickly carried downward and inward toward the breast-bone, bringing the elbow sharply against the front of the chest, the right thumb in the armpit giving the proper direction to the head of the bone (as in the figure). If you do not succeed the first time, try again, and success may attend the third or fourth effort.

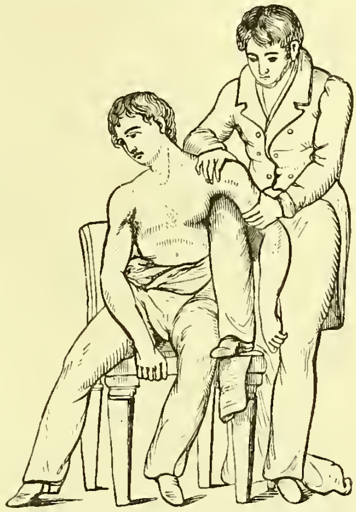


FIGURE 313.—Replacing a dislocated shoulder, the knee being used as a fulcrum over which to pry the head of the bone outward and upward into its place.

Another method, and a good one, of reducing a downward dislocation, is to place the patient in a chair in a natural position; the operator standing behind him puts his foot upon the outer edge of the chair and brings his knee well into the patient's armpit, the injured arm hanging over the operator's leg. (See Fig. 313.) If the left shoulder is out the operator puts his right foot upon the chair, holds the top of the shoulder steady by grasping it with his right hand, and then with his left hand seizes the arm just at the

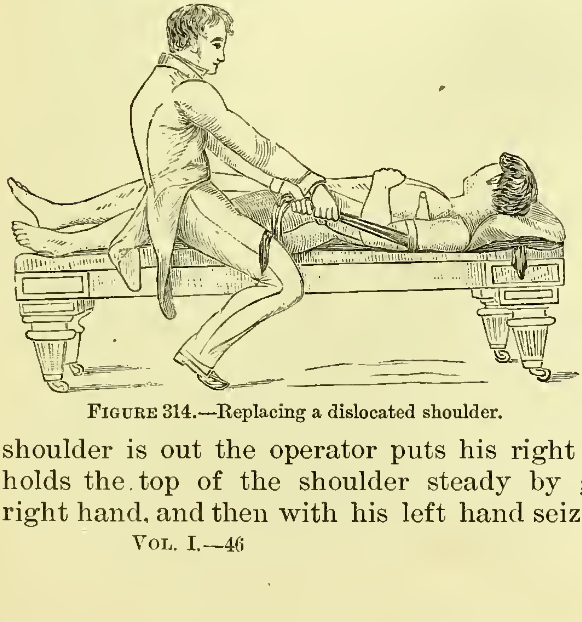


FIGURE 314.—Replacing a dislocated shoulder.

elbow and forces it toward and under his leg, thus making a lever of the bone, with his leg as the fulcrum. Should these means be unsuccessful, the patient should be seated and one hand of the operator be pressed firmly upon the shoulder of the patient while stand-

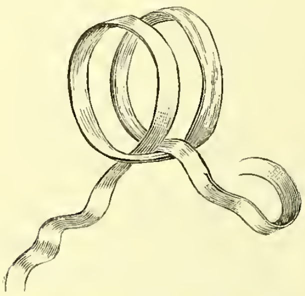


FIGURE 315.—A clove-hitch.

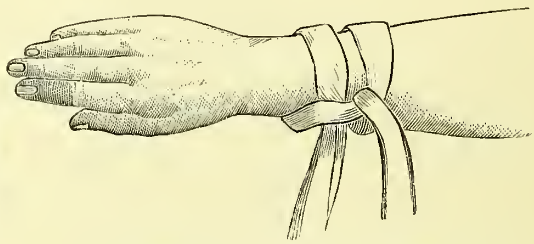


FIGURE 316.—A clove-hitch adjusted.

ing behind him, while the forearm should be grasped near the wrist with the other hand. The arm should then be raised directly upward. A modification of this method is to have the patient sit upon the floor with his back to a chair on which the operator stands. He, putting his foot firmly upon the injured shoulder, draws the arm straight upward.

The most common, and in most cases the simplest practice, is to stretch the patient at full length upon the floor or a low couch. (See Fig. 314.) The operator also sits down upon the floor facing the patient, with his body close to the legs on the injured side. He then places his heel, divested of the boot, into the armpit and presses it closely against the dislocated head of the bone. At the same time he takes the arm above the wrist firmly in both hands and pulls directly downward. After the extension has been kept up for half a minute or more, carry the arm slowly in toward the patient's body, when the head of the bone will usually glide into its socket.

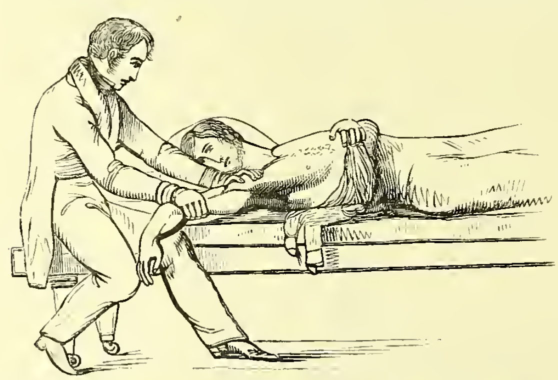


FIGURE 317.—Reducing a dislocated shoulder by making extension upwards.

In all these forms of reduction the pulling should be steady and

gentle, holding on for a long time to tire out the opposing muscles, and increasing the force applied very slowly. If sufficient extension cannot be made by taking the limb near the wrist, a stout bandage of linen may be applied above the elbow in the form of a "clove-hitch" (see Figs. 315 and 316), and the operator pulls upon the loose ends of the bandage as in Fig. 314. A very simple and rustic means of relief is afforded in the fence or gate plan figured below, and which does not require much explanation. The main thing is to secure a hold as low down as possible and then throw the whole weight of the body upon the displaced head of the arm-bone, forcing it outward and upward into place. In the woods or upon shipboard a temporary gate could be constructed, if the patient prefers, or is obliged to set his own bones.

In the dislocation described as sub-spinous, where the head of the bone lies back upon the shoulder-blade, the operator should sit or stand a little behind the patient, and, seizing the shoulder as shown in the cut illustrating extension upward (Fig. 317), should press his thumb firmly upon the head of the bone to push it forward, and at the same time should take the elbow in his other hand, and, while pulling it downward, should draw the elbow backward, at the same time rolling or *rotating* the arm to carry the head over the edge of the socket. Of course, if the displacement is of long standing, or even if all these methods fail in a recent case, ether or chloroform must be used, when reduction will probably be accomplished.

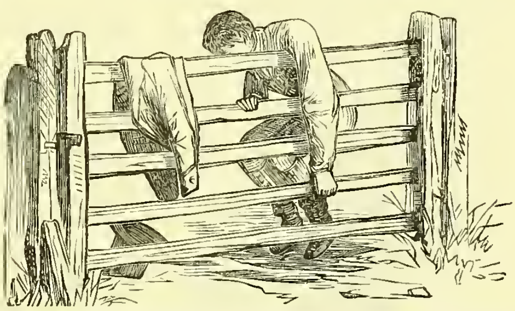


FIGURE 318.—Method of replacing a dislocated shoulder without assistance from others.

Dislocations of the Elbow.

Dislocations of the elbow are more common in childhood than in adult life ; more than half the cases occurring between the ages of five and fifteen, and a large proportion of the rest happening before the age of forty. Both bones of the forearm, viz., the *radius*, which forms the thumb side, and the *ulna*, which lies upon the little finger side of the arm, may be dislocated backward, outward, inward, or forward. The ulna alone may be dislocated backward, leaving the other bone in place, or the head of the radius may be driven forward or backward. These dislocations

may be complete or incomplete, simple or compound, and they are frequently complicated with fracture of one of the bones forming the elbow-joint. The most common dislocation, however, is the one first mentioned, viz., of both bones backward, while the dislocation of both bones forward is almost invariably complicated with fracture. It requires great force to produce a dislocation of the elbow, and extensive laceration of the ligaments is inevitable. It is usually caused by a direct blow upon the elbow, or an indirect one upon the hand from a fall, or a sudden and severe twist.

Symptoms.—If seen at once, it is easy to recognize this dislocation, but if much time elapses before an examination, the excessive amount of swelling makes it difficult, as it covers the points of the bones upon which we rely in deciding the case. In this dislocation, more, perhaps, than any other, a comparison of the injured with the sound side is essential to a correct diagnosis. A

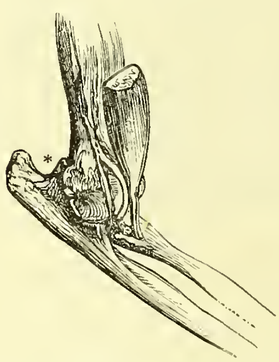


FIGURE 319.—Position of the bones in backward displacement of the elbow. The * is placed in the natural socket.

FIGURE 320.—Dislocation of both bones of the arm backward.

careful examination of the sound elbow will teach one where to look and feel for the various prominences that exist, and the absence of these or the existence of any unnatural depressions will guide one to a correct opinion.

When both bones are dislocated backward the forearm is found partially bent, with the palm of the hand slightly turned downward, while the point of the elbow or "funny bone" projects, as seen in the cut. The inside of the upper arm is somewhat prominent, looking as though it was curved slightly forward, while the diameter of the joint from the point behind to the bend of the elbow forward is considerably increased.

The arm may be drawn down almost straight without causing much pain, while any attempt to *bend* it beyond a right angle

causes great suffering. In some cases the head of the radius can be felt in its unnatural position when the forearm is turned.

In dislocation of both bones *outward*, the prominence upon the inner side of the lower end of the upper arm bone, which is called the inner condyle, is very marked, when seen from behind. In dislocation *inward*, the reverse is true, as the outer condyle is then most prominent.

In displacement of the inner bone or ulna *backward*, the hand is turned downward, and twisted inward, while the shortening of that side of the arm and the prominence of the "funny bone" backward, makes the recognition of the nature of the injury sufficiently clear.

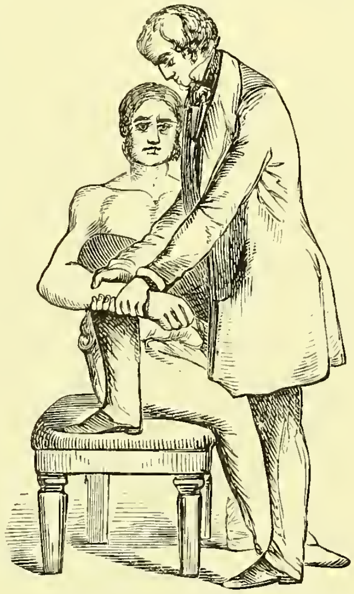


Figure 321.—Mode of replacing a backward dislocation of the elbow.

When the head of the outer bone or radius is dislocated, its absence from its natural position, and its presence in an unnatural place is a sufficient guide, especially if motion of the joint is limited or impossible.

Treatment.—In many cases the reduction is easily effected by the most simple manipulation, especially if the attempt is made soon after the accident. Bryant says the bones "may be moulded into place with the hands," but if swelling has occurred, more definite and decided measures are necessary. Sometimes merely bending the inside of the elbow over the surgeon's knee, while his foot is placed on the seat of the patient's chair, is sufficient.

In other cases the bones may be set by holding the forearm firmly with the left hand, while the right hand grasps the elbow-joint, the fingers pressing back the upper bone, while the palm of the hand presses the point of the elbow forward. Or, both hands of the operator may be interlocked in front of the arm which may be pulled backward, while forward pressure is made by the thumbs against the point of the elbow. Of course, the use of ether will facilitate all the modes of reduction, as the muscular resistance is often very great. Pulling the arm straight downward or outward with the right hand, for a few seconds, and then bending the elbow while the left hand grasps the joint and presses the elbow forward, will often succeed when all other methods have failed. Bryant lays

it down as a rule, that when both bones are displaced, or the ulna alone, the operator should grasp the forearm as a whole ; but when the radius is displaced, the extending force should be applied from the hand. This dislocation is always followed by considerable inflammation and swelling, which may increase after the bones are replaced, and hence the arm should be kept in a sling, and cold water or ice applied, if necessary. Motion may be attempted in about two weeks, and should be persevered in until motion is fully restored.

Dislocations of the Wrist.

These can always be distinguished by the altered position of the hand, which varies as one or both bones are displaced, but any dislocation of the wrist is exceedingly rare, the more common form of injury being "Colles' fracture," which is elsewhere described.

Symptoms.—When both bones are displaced the hand is either thrown forward or backward, while the ends of the two bones of the arm are seen and felt either above the back or below the palm of the hand. There is an absence of grating sensation when the bones are moved, and constant pain, which is increased by any attempt at motion. This accident is, however, rarely met with, even in hospital practice.

Treatment.—Simple extension in a straight line suffices to reduce this dislocation. The operator grasps the hand of the patient, while an assistant holds the arm steadily, and then pulls in line with the arm, when the bones will slip into place. If it resists simple extension, another assistant may render valuable aid by pressing the lower ends of the bones of the forearm upward with one hand, while with the other he pushes the bones of the wrist downward, while extension is still being kept up. Splints should be applied for a fortnight after reduction to enable the parts to regain strength.

It occasionally happens that one of the small bones forming the wrist proper is displaced by some direct violence. No definite rule can be laid down for the treatment of such a dislocation, as it must be moulded into place by manipulation and extension.

Dislocation of the Thumb.

This is by no means an unusual accident, and it may be displaced in either direction, backward or forward, but more frequently the former. It is generally occasioned by a fall or blow

upon the head of the thumb, causing the inner end of the large bone to slide back upon the upper surface of the metacarpal bone, that is, the end of the thumb bone or "*phalanx*" nearest the hand is forced *above* the "metacarpal" bone which forms that part of the hand. It is very rarely forced under the metacarpal bone, as stated above.

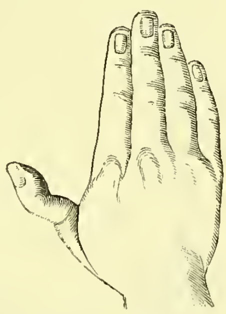


FIGURE 322.—Dislocation of the end of the thumb backward.

Symptoms.—The recognition of this is easy, for the thumb has a double bend, both points being bent at the same time, while the end of the metacarpal bone projects strongly into the palm of the hand.

Results.—This joint is always weakened by dislocation, and scarcely ever recovers its former strength, but "flies out," wholly or partially, upon very slight provocation. Some persons have the power of producing partial dislocation of this joint voluntarily, after it has once been completely displaced.

Treatment.—This has varied very much, as surgeons have succeeded first with one method and then with another. Direct pulling or extension has often succeeded in reducing this as well as dislocation of the bones of the finger, and for this purpose the "clove-hitch" has been used to secure a purchase. The mode of application is obvious. One surgeon recommends that the injured thumb be thrust through the ring-handle of a large door-key, and extension be made by pulling upon the shaft of the key. Dr. Levis, of

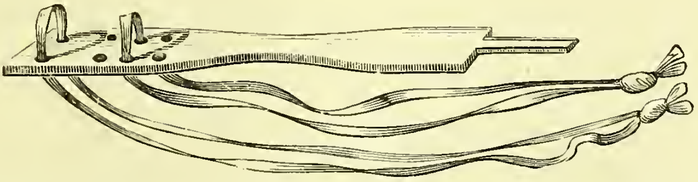


FIGURE 323.—Dr. Levis's instrument for replacing dislocation of the bones of the finger or thumb.

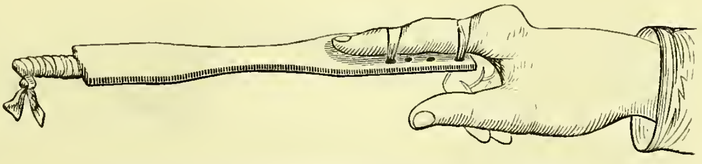


FIGURE 324.—Mode of applying Dr. Levis's instrument.

Philadelphia, has devised an instrument which holds the thumb or finger very securely and enables the operator to use force to the

best advantage. It consists of a thin strip of hard wood ten inches in length and rather more than an inch in width. One end is perforated with six or eight holes. The opposite end is partly cut away, leaving a projecting pin and a shoulder on each side of it.

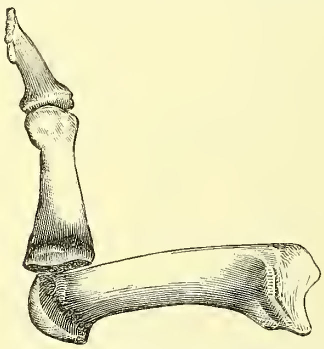


FIGURE 325.—Prof. D. Crosby's method of restoring a dislocated thumb.

The sides of the strip are somewhat hollowed to give the operator a more secure hold. Two pieces of strong tape, about a yard long, are prepared, and each of them passed through a pair of corresponding holes in the wood, leaving two loops upon the same side of the strip. The tapes may be passed through the different holes so as to vary the distance between the loops and thus fit it to either the thumb or the finger, as desired. To apply this apparatus the thumb is passed through the loops, the loop nearest the displaced joint is tightened by drawing on the tape, which is then drawn along the under side of the wood across the shoulder near its end, and secured by winding it firmly around the projecting pin. The other loop is to be tightened in a like manner, only winding it around the pin in an opposite direction ; then the tapes are finally tied together. By means of this machine the operator can use direct extension, flexion, or leverage.

Replacement is sometimes effected by drawing the thumb from the hand and twisting it, extension being meanwhile kept up. Dr. Gross says, "trial should be made of the excellent method of Prof. D. Crosby, of New Hampshire, originated by him in 1826, and since recommended by Gerdy, of Paris. It simply consists, as the adjoining cut clearly exhibits, in pushing the phalanx back until it stands perpendicularly on the metacarpal bone, when, by strong pressure against its base from behind forwards" (while holding the whole thumb in the same position relatively to the hand, its base is carried beyond the obstacle), "and by flexion it is readily carried now into its natural position." In other words, having the patient's hand in front of you, tilt the thumb upward and backward with both your forefingers, while with your thumbs you make steady pressure against the lower end of the

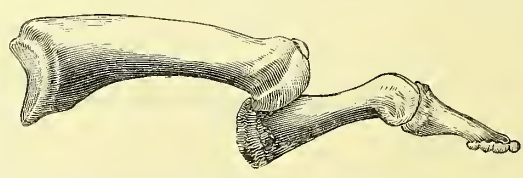


FIGURE 326.—Dislocation of the second bone of a finger forward.

bone. Should all these fail there is but one resource left, and that is to cut the tendon of the long muscle which closes the thumb upon the palm, and if this does not relieve the tension, other tendons and even ligaments must be divided until the head of the bone can be returned to its place.

If the dislocation of the thumb is *forward* or upon the *inner* surface of the hand, it is held there, in most cases, by the tendon of the muscle that straightens or "extends" the thumb, and all that is necessary is for the operator with one hand to bend the thumb or finger forcibly upon the palm, *shutting* it closely, and then by manipulating the head of the bone with the thumb and fingers of the other hand, it will be readily replaced.

Dislocation of the Fingers.

These may be forward or backward, like those of the thumb, the most common being the latter. These displacements are easily

FIGURE 327.—Backward dislocation of the first bone of a finger.

recognized, and can readily be reduced by direct extension or by bending, and then extending, as in Figure 325.

DISLOCATIONS OF LOWER EXTREMITIES.

Dislocation of Hip.

Dislocations of the head of the thigh-bone are always very grave accidents both from the amount of force required to throw the "whirl bone," as it is called, out of its deep socket in the hip, and from the great tearing of ligaments that necessarily occurs. It is, however, much less formidable now than in ancient times, owing to a better knowledge of the anatomy of the parts, and consequently, to our improved and simpler methods of effecting reduction. It is singular, however, that suggestions as to the treatment of this important dislocation made by Hippocrates 450 years be-

fore the Christian era, and which were practically ignored by medical men for many centuries, have, within the present century, been adopted by all surgeons, and form the basis of modern treatment. Surely "there is nothing new under the sun."

Dislocations of the hip are found mostly in males between the ages of fifteen and forty-five years of age, but occasionally in the very young and very old. Cases are recorded at the ages of six months to six years, while, upon the other hand, persons of sixty to eighty-five have been the victims of this accident. This displacement is always the result of violence, as great force is required to tear through the strong tissues that bind the head of the thigh in its deep cup. Very rarely this dislocation occurs as the result of slight force, such as a twisting of the limb, but it is probable that it is the result of some inborn weakness or deficiency of the joint itself. Children are sometimes born with dislocated hips, but it is caused by disease.

There are four forms of this displacement, named from the position the head of the thigh-bone assumes when forced from its socket. There are, also, varieties of each form as the dislocation is complete or incomplete, and there is good reason to believe that the head of the bone may rest at any point round its socket. The four principal varieties are given in the order of frequency:

First. Dislocation *upward* and *backward* from the socket, the head of the bone resting upon the back part of the haunch or *pelvic* bone. This is called dislocation upon the "*dorsum illi*," or back of the *ilium*. This is the most common form.

Second. Dislocation *downward* and *inward*, the head of the bone resting on the oval opening at the lower portion of the front of the pelvis, called the "*foramen ovale*." This is second in frequency.

Third. Dislocation *backward* into the notch, at the lower part of the back side of the pelvis, called the "*sciatic notch*." This is a variety of the first form, as the head of the bone simply lies lower down. This is the third form in frequency.

Fourth. Dislocation upward in front of the pelvis, resting upon that portion of the bone which is called the "*pubis*." Here the head of the thigh-bone is forced above the oval opening mentioned in the second form, and this dislocation is the rarest of all.

In all these cases the "*capsule*," or bag which encloses the joint, and the "round ligament" which connects the centre of the head of the thigh-bone with the bottom of the socket are torn across, and the tendons and muscles about the joint are more or less torn.

Dislocation upon the Back of the Hip-bone.

The *first form* given comprises at least one-half of all the dislocations at this joint, and is usually caused by a fall or blow upon the outside of the thigh while the leg is strongly drawn inward toward its fellow, or from a very heavy weight received when the body is in a stooping position. In either case the force applied is very great. This dislocation is easily recognized by noticing the following points :

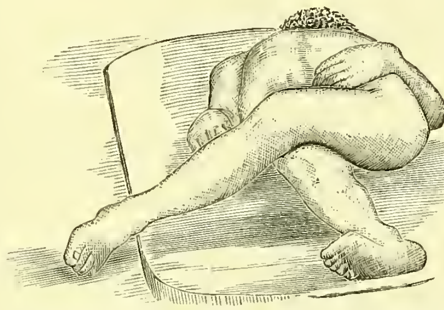


FIGURE 328—Position of the limb in dislocation of the head of the thigh-bone *high up* on the back of the hip, when the patient is lying down.

1*st*. The thigh is bent, and the knee, when the patient is standing, is carried in front of, but above the other.

2*d*. The whole limb is twisted or rotated inward with the great toe resting upon the instep of the opposite foot.

3*d*. The great prominence of the bony protuberance upon the upper end of the thigh-bone, just outside the joint, which is called the "*Trochanter Major*," and its being drawn toward the bony point upon the front of the hip-bone called the "*Superior Spinous Process.*" (See page 735.)

4*th*. The raising up of the fold of the buttock on the injured side.

5*th*. The absolute impossibility of motion, and the great pain produced by any attempt to draw the leg outward, or to straighten it, and finally,

6*th*. The evident shortening of the injured limb from one and a half to two and a half inches.

When the patient is very thin the head of the bone may be readily felt in its unnatural position on the back of the haunch-bone, while in all cases there is an unnatural fulness at this point. The patient will sometimes be able to support the weight of the body upon the injured limb, and will even submit to slight bending of the leg and drawing the knee toward the sound side.

This dislocation is sometimes mistaken for a fracture of the neck of the thigh-bone, and, conversely, the fracture is mistaken for a dislocation, but this can rarely happen, even to non-professional persons, if they will consult the following table of differences between them.

Differential Signs between Fractures of the Neck of the Thigh-bone and Dislocations of the Thigh Upward and Backward.*

Dislocations Upon Back of Hip-Bone.	*Fractures of Neck of Thigh-Bone.*
1. Very rare in aged persons.	1. Very frequent in old age.
2. Never caused by a fall upon that prominence upon the outer aspect of the upper end of thigh-bone, called the "*great trochanter*."	2. Often caused by a fall upon the "*great trochanter*."
3. Absence of *crepitus* or grating.	3. Crepitus present.
4. Unnatural stiffness or loss of motion.	4. Limb can be moved freely, except when motion causes pain.
5. Limb always shortened.	5. Limb not always shortened.
6. Limb almost always turned inward, drawn toward sound limb, and bent.	6. Limb never in this position, but is almost always slightly turned outward, and generally it lies in the same direction with the other limb.

The *second form* (that into the oval opening in front of the pelvis) is generally caused by some sudden and forcible drawing outward of the knee or foot; the head of the thigh-bone at the same time being forced by this leverage into the position described. The signs of this dislocation are well marked.

1*st*. The body (if standing) is bent forward and toward the injured side, while the foot is pushed forward and slightly outward.

2*d*. The bony prominence at upper end of thigh-bone (the *great trochanter*) is carried toward the middle line of the body, and consequently there is a visible flattening of the hip.

3*d*. There is a hollow below the front of the pelvis, under what is called the *upper* "*spinous process of the ilium*," and the fold in the buttock is absent.

4*th*. The limb is longer than its fellow by about two inches. The head of the bone can often be felt in its new position. It is a singular fact that the patient can at times walk quite well after this accident.

The *third form* of this dislocation, in which the head of the bone is forced backward and downward into the great notch behind the socket in which the head of the thigh-bone rests (see side view of the skeleton on page 13), constitutes about one-seventh of all dislocations of the thigh, and is a variety of the first form in which the head of the bone lies also upon the back of the haunch, but higher up. The symptoms in this are very similar to those described in the first form, but are less marked. There is less shortening and less bending of the limb, and it is not drawn

* Taken from Hamilton's Surgery.

as strongly toward its fellow. The *trochanter* is also drawn up and twisted outward, but not to so great an extent, and the head of the bone is not to be felt in its new position. The shortening of the limb being less, the toe rests upon the ball of the great toe of the opposite foot, when the person is standing, instead of on the instep, as in the first form.

FIGURE 329.—Position of the limb in dislocation of the head of the thigh-bone into the *sciatic notch*, when the patient is lying down.

Dislocation upon the upper portion of the front of the pelvis, called the *pubis*, is the last and least common form of displacements of the hip. It is caused by some force which draws upon the leg very powerfully—the lowest portion of the body being thrown forward, and the belly and chest bent backward. Or it may be produced by a fall upon the foot, when the lower part of the body and the belly are forced violently forward. The only case of this form of dislocation ever seen by the writer happened to a railway brakeman, who while "making up a train" got one foot firmly caught and wedged in a "frog," while the moving car, to which he clung, crushed him downward and forward upon his face.

This dislocation is marked by the twisting outward of the limb, which is also drawn out from the central line of the body. The foot is also turned outward, with the toes directed at a right angle with their usual position. The head of the bone can usually be felt, and perhaps seen, either close to the upper edge of the front of the *pubis* in the groin, or it may be discovered near the inner edge of the socket from which it has been forced.

Sometimes the head of the thigh is carried above the pubic bone, and then it forms a very prominent projection just above the groin.

Diagnosis of Dislocations of the Hip.

With reasonable care an intelligent person ought to be able to make out these various dislocations, but in certain cases they are liable to be confounded with fractures of the neck of the thigh-bone (see page 732). A table has already been given, showing the difference in the symptoms between the first form of this dislocation and fracture, and the signs there given will also help distinguish between a fracture and the third form described, viz.: downward and backward into the "sciatic notch." Cases of fracture of the

neck of the thigh-bone sometimes occur, however, when the fragments are driven into each other (impacted), and in which the leg is bent and foot turned inward, as in this third form of dislocation. The distinction is that the head of the bone can be moved in its socket if the leg is gently handled, while in dislocation there is almost total want of motion. In cases of doubt under these circumstances, it is unlikely that any one but a surgeon would be able to distinguish the true nature of the accident. The importance of a correct decision in the matter depends upon the fact that an *impacted* or *telescoped* fracture should *never be disturbed,* but should be left to unite in its new position.

Occasionally, in adults, the deformity will return when the bone has apparently been set, and in case this occurs it is probable that the lip or rim of the socket has been broken off, or the rounded head of the thigh-bone itself may be fractured. In a child this last accident may occur, the head of the bone being separated at the place of its union with the shaft. In both these cases the fact that the bone can only be held in position by means of splints, pulley and weight, or some other apparatus, sufficiently proves that we have not a dislocation to deal with, but a fracture.

A French surgeon has given what he calls an infallible test for the detection of dislocations of the hip. If the reader will refer to the anatomy of the bones forming the pelvis or lower portion of the trunk, he will see a small prominence upon the upper and forward of the brim of the pelvis, called the *anterior upper spinous process*, while upon the lower portion of this haunch-bone is found a large bony mass or protuberance upon which the body rests when sitting, called the *tuberosity of the ischium.* The test consists in drawing a line with ink or charcoal, from the upper point to the lower, upon the injured limb. Now, in a healthy and uninjured joint the *trochanter*—or large prominence upon the outer portion of the upper end of the thigh-bone—in every position touches the *lower* border of this line, while in a dislocated limb the *trochanter* is found *above* this line, sometimes as much as an inch. This test is said to be especially useful in detecting dislocations upon the back of the hip-bone, as in the first and third forms.

Treatment of the First Form.

As heretofore remarked, a radical and beneficial change has occurred in the method of setting or *reducing* dislocations of the hip, the change being from brute force, *improperly* applied, to the gentlest of skilful manipulation. The mistake once made was owing to an erroneous idea as to the force which holds the head of

the bone in its unnatural position, and causes it to resist misdirected efforts for its reduction. It was believed that the contraction of the muscles of the hip and thigh constituted the main obstacle, and hence great force in the way of pulling or *extension* with compound pulleys and other apparatus was employed to overcome the resistance offered by muscular contraction; whereas modern science has demonstrated that the muscles have little to do with the difficulties we sometimes encounter in our efforts to reduce this dislocation. It has also been proved that these difficulties reside in the *capsule* or bag which encloses the joint, and in the ligaments which strengthen it, a large rent in the capsule permitting easy reduction, while a small one may cause great annoyance and delay, the head of the bone being held in the tear as in a tight button-hole.

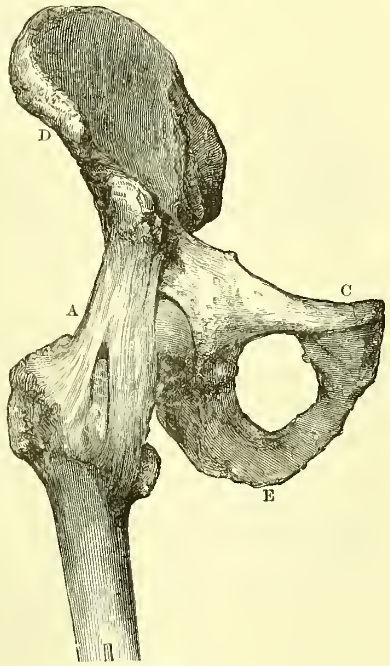


FIGURE 330.—Showing the Y-ligament on the outside of the right hip-joint. A, the Y-ligament; B, the foramen ovale or oval opening; C, the pubic bone; D, the anterior superior spinous process; E, the "seat-bone" or ischium.

Dr. Bigelow, of Boston, has recently demonstrated that one of the ligaments which covers and forms a part of the capsule or bag is the chief agent in determining the position of the head of a dislocated thigh-bone upon the pelvis. This ligament, which is *twisted* in this dislocation, is called by Bigelow the **Y**-*ligament*, having the shape of that letter inverted. It is called by anatomists the *ilio-femoral* ligament, as it extends from the lower spinous process upon the front to the pelvis over the joint, and is attached to the upper end of the *femur* or thigh-bone by two extremities, one of which is fastened below the inner or smaller *trochanter*, and the other extremity below the outer or larger *trochanter*, as seen in the figure. Both these divergent branches remain untorn in the ordinary dislocation of the hip, and their attachments should be borne in mind when we meet with any difficulty in our attempt at reduction.

In the improved method of reduction of dislocations by manipulation, a correct knowledge of the relations of the **Y**-ligament is useful, if not indispensable; but there is one mode which frequently succeeds, and which should be tried before the limb is handled at

all otherwise. This is called the "Ready or Automatic Method," and was first described by Dr. Allen, of Vermont, who practised it as early as the year 1841, and which has since been recommended by Dr. Bigelow. It consists in simply placing the patient upon his back (upon the floor preferably), while the operator stands over him with the injured limb between his legs. He then places the ankle of the patient between his own thighs, the back of the foot pressing against his buttocks. Then clasping his hands just below the patient's bended knee, as seen in the adjoining figure, he lifts steadily until the patient's body is raised from the floor. Holding him in this manner for a few seconds the operator will probably have the pleasure of hearing the "*click*" which denotes that the head of the bone has slipped into its socket.

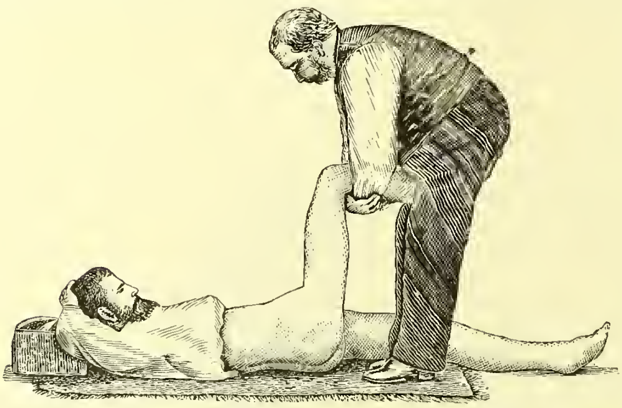


FIGURE 331.—Automatic method of reducing dislocation of the hip. First form.

This method of reduction is especially successful in all cases of dislocations upon the back of the pelvis; but, as will be hereafter described, many dislocations forward upon the front of the pelvis are changed by manipulation from one point to another, around the socket, until, finally, the head of the thigh-bone rests upon the back of the hip-bone or *ilium*, before reduction is effected. Hence, the automatic method may be given a trial after manipulation has produced this change of position.

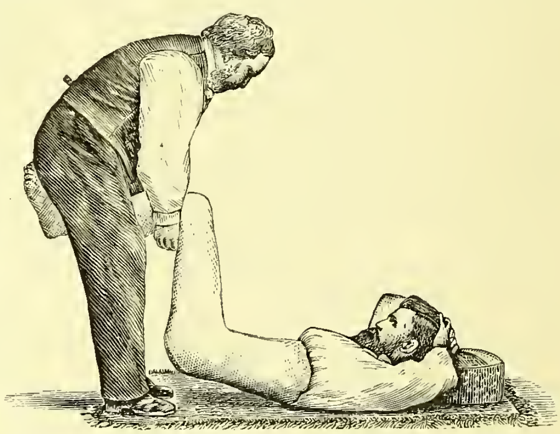


FIGURE 332.—Automatic method of reducing dislocation of the hip. Second form.

To recapitulate, the lower part of the body is to be lifted from the floor and held immovable. The weight of the hips and opposite limb turns the body outward, producing just sufficient extension and drawing, or "*abduction*" of the injured limb away from the body, to allow the head of the bone to slip through the slit in the capsule and direct it into the socket.

In case this should fail from any cause, the second form of the automatic method may succeed. In this the operator stands over both limbs of the patient, and lifts both instead of one, as directed above. Here both hips are raised from the floor, the hands of the operator forming a fixed point of counter-extension, the weight of the hips and trunk make extension, and thus, instead of carrying the head of the thigh-bone into the socket, the socket itself glides over the head of the bone.

Reduction by Manipulation.

If the dislocation is recent, the bone may generally be replaced without the use of ether, but in the more rare and difficult forms, and in long-standing dislocations, the services of a surgeon and the aid of ether are indispensable, as the unconscious condition of the patient encourages the use of a dangerous amount of force. In reduction by manipulation, the position of the patient is the same as in the automatic method, but it is more convenient to have him laid upon his back on a bed rather than upon the floor. The operator, then, in case of the right leg, seizes the ankle with his right hand, and the under side of the knee with his left, and first, bends the leg at a right angle with the thigh, to gain a leverage (as in Fig. 333).

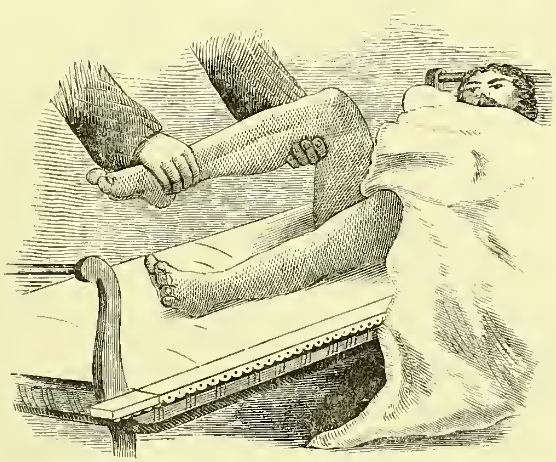


FIGURE 333.—First stage of the method of reducing a dislocation of the hip by manipulation.

2d. The thigh is bent at little more than a right angle with the body (as in Fig. 334), to relax the Y-ligament. Be careful not to bend the thigh until it touches the belly, as there is danger of breaking the neck of the thigh-bone and tearing the tissues

about the joint. If the manipulation thus far has been properly performed, the head of the bone has dropped down upon the back of the hip-bone, and is ready to be carried upward over the edge of and into the socket.

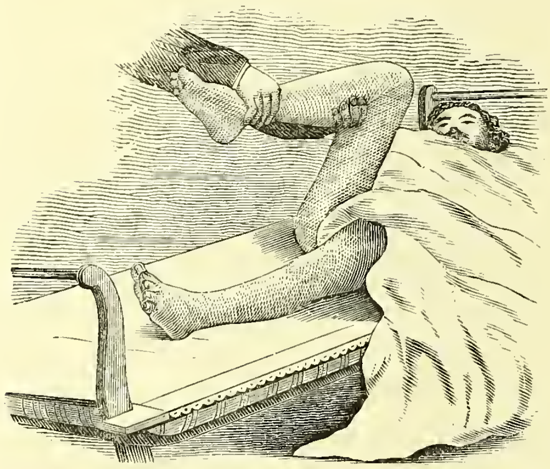


FIGURE 334.—Second stage of the same method.

3d. Draw the thigh outward from the body (*abduction*), and at the same time twist or rotate it outward (as in Fig. 334).

4th. While the limb is carried outward, and also twisted outward, bring it slowly down to its natural position.

It should be mentioned that reduction sometimes occurs unexpectedly when the thigh is in the second position, that is, flexed at more than a right angle, and this is caused by "self-twisting," as it has been called. Hamilton says this natural inclination to "self-twisting" should be favored by the operator, and that it is proper, under these circumstances, to use some force in drawing the leg outward from the body, so that the head of the bone may be made to rise over the edge of the socket. It is also well to favor this tendency to replacement by lifting strongly upon the knee, while the direction of the thigh outward is still kept up. Reduction at this stage of the manipulation is also aided by giving the leg a slight to-and-fro motion. Twenty-two centuries ago Hippocrates suggested this mode of favoring

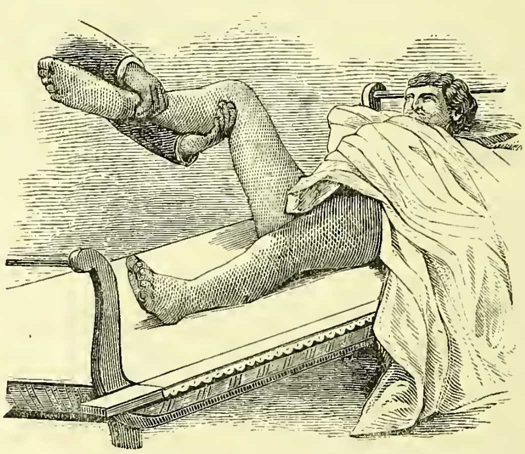


FIGURE 335.—Third stage of the method by manipulation for replacing a dislocated hip.

reduction, for he taught his pupils to "bend the dislocated limb at the joint with gentle shaking."

If neither the automatic method nor manipulation brings the bone into place after repeated trials, there is nothing left but to try extension by means of pulleys. [This method requires more judgment and experience than most non-professional persons can possess, and it will, in most cases in which it is decided to be necessary through the failure of the foregoing methods, be found to be better for the patient to await the arrival of a surgeon, even though he may be summoned from a considerable distance.—Ed.]

Dislocation Backward into the Sciatic Notch.

Although this is the third form of dislocation of the hip, its reduction is treated of here as it is a variety of the first form, and most of the rules for manipulation apply equally to both.

Signs.—As stated heretofore, the head of the bone in this dislocation is forced backward into the sciatic notch, this notch being situated at the lower edge of the haunch-bone, and through it are transmitted the greater and lesser sciatic nerves, some smaller nerves, some large and small blood-vessels, etc., in their passage from the trunk to the limbs and lower portion of the body. The symptoms of the displacement are much the same as in the first form, but are less marked. There is less shortening, less drawing inward of the limb, but the limb itself is a little more bent; the trochanter is drawn up and twisted outward, but not to the same extent, while the head of the thigh-bone is not often to be felt in its new position. To the eye the limb seems to be in the same position as in dislocations upon the back of the hip-bone, but there being less shortening, the toe of the injured side rests upon the ball of the other great toe, instead of on the instep; or the limb will occupy the position shown in Figure 329, when the patient is lying down.

Figure 336.—Method of replacing a dislocation of the head of the thigh-bone into the sciatic notch.

Treatment.—The same manœuvres are to be practiced here as in the first forms, namely: bend the leg upon the thigh; bend the thigh upon the body (the knee will be drawn inward toward the sound side); draw the thigh outward from the body, at the same time twisting or rotating the whole leg outward, and finally, slowly straighten the leg. When the thigh is bent upon the abdomen, and the drawing and twisting of the limb outward has commenced, remember to give the leg the

vibratory, to-and-fro, or shaking motion already described, although it is not quite as likely to succeed here as in the first form.

Dislocation Downward and Inward upon the Oval Opening ("Foramen Ovale").

This second form of dislocation of the hip is usually caused by some sudden and very forcible drawing *outward* of the knee or foot to such an extent that it tilts the head of the thigh-bone inward. It has happened to a person whose limb was forcibly drawn outward while alighting from an omnibus, and to another while walking upon ice, one foot slipping suddenly outward, while the other foot was firm. A fall upon the feet with the legs spread widely apart has also produced this dislocation.

Signs.—It is characterized by the bent position of the body (when the patient is standing), it being drawn forward by important muscles (the psoas and iliac) ; by the pointing of the foot forward and slightly outward ; by the drawing of the trochanter toward the middle line of the body, so that the prominence formed by it in its natural position is wanting, and is, indeed, replaced by a depression, or flattening of the hip ; and finally, it is known to be a dislocation by the absence of *crepitus* or grating. There is also the absence of the fold of the buttock ; while the knee is slightly bent and cannot be straightened. The most marked symptom, however, is the lengthening of the leg by about two inches, and its being forced considerably outward from its fellow, so that the foot of the injured side is widely separated from the other. Any attempt at movement causes pain. In thin persons the head of the bone can be felt just under the groin. It is singular that the patient can, at times, walk with such an injury.

Treatment.—The most recent method practised for reduction of the inward dislocation, is that recommended by Hamilton, and is accomplished by leverage and lifting. The patient lying upon his back on a bed, a folded sheet is passed around the lower part of the hips (pelvis), the ends crossed over the belly and each one held by an assistant, one at each side of the bed. Another assistant upon the uninjured side of the patient, passes his hand under the sound limb and grasps the ankle of the affected side. The operator, meanwhile, stands upon the dislocated side in a stooping position, with a strong band over his shoulders, which is also carried between the patient's legs and as high as possible over the dislocated thigh. The first pair of assistants draw upon the ends of the sheet to steady the pelvis ; the other assistant draws the injured limb toward him, under and across the sound

limb, while the operator, by standing erect, lifts the head of the bone forward and outward, and slightly upward—that is to say, toward the head of the patient.

The *second* method, by manipulation (Bigelow's), is effected in the following manner: The patient lies upon his back on the floor, while the operator, standing upon the injured side, seizes the ankle with one hand and the knee with the other, bends the limb so that the thigh is perpendicular, and the bent knee pointing upward. He now draws the leg a little outward to loosen the head of the bone from its position upon the oval opening. Then twisting or rotating the leg strongly toward the body, he carries the limb across the body, bringing the knee to the floor. In difficult cases a long towel may be passed between the patient's legs, carried upward around and over the head of the thigh-bone, and be drawn upon by an assistant standing near the patient's head. This draws the head of the bone upward and outward, and assists the operator in his efforts to tilt the bone over the rim of the socket by means of the descending knee. Sometimes success follows rotation of the limb *outward* when inward rotation has failed. The operator may also aid reduction by making pressure inward and upward upon the head of the bone, when, by his standing erect, he has drawn the head of the bone upward.

FIGURE 337.—Bigelow's method of replacing a dislocation of the head of the thigh-bone into the oval opening.

The *third* method of reducing this dislocation, by drawing the head of the bone outward and upward, is performed by placing the patient on his back upon a bed with one of the bed-posts between his legs and closely pressed against his body (this involves the use of an old-fashioned post-bedstead). The operator, standing upon the sound side, should then seize the ankle of the injured side and draw the foot and leg inward, carrying the foot across the middle line of the body. In this the bedpost acts as a fulcrum and throws the head of the bone outward. Be careful *not to raise the foot* in doing this, as you might thus carry the head of the bone into the sciatic notch instead of the socket. If, however, this should happen, it is to be treated as an original displacement backward, and be reduced by the proper manipulation, above described.

Dislocations Forward and Upward upon the Pubic Bone.

This forms the fourth and last form of dislocations of the hip and is probably the rarest of all these displacements. It is usually the result of indirect violence, such as falling on the foot when the leg is stretched backward, or stepping into a hole while walking—the motion of the foot being suddenly stopped, while the body goes forward. It may also be caused by *any* forced drawing or extension of the thigh, the hips being thrown forward, and the body above the hips bent backward, and it may also happen from a blow or fall upon the pelvis.

Signs.—With care, the existence of this dislocation ought to be made out, although certain fractures of the neck of the thigh-bone may present signs somewhat like them. The sudden loss of motion, with stiffness of the limb, the absence of grating, and positive signs of displacement of the head of the bone, are sufficient to exclude the suspicion of fracture. Other symptoms are shortening of the limb, which is drawn away from its fellow, while the foot points directly outward; there is great depression of the trochanter, a hollow taking the place of that bony prominence, and the head of the thigh-bone is found in the groin, where it may both be seen and felt.

Treatment.—Reduction may be effected by Bigelow's method much in the same manner as in the last dislocation considered, namely, that into the oval opening, excepting that in this displacement, the bent limb should be carried across the sound thigh at a higher point. First, then, bend the leg slightly to relax the **Y**-ligament, at the same time drawing downward to bring the head of the bone down further upon the pubis; then draw the leg a little outward (*abduction*), and twist or rotate the limb inward to free the bone completely. Lastly, while rotating inward, and still pulling on the thigh, carry the knee inward and downward to its place by the side of its fellow. In some cases this manipulation may be assisted by drawing the extreme upper part of the thigh outward by a towel passed between the legs and over the groin of the affected side and managed by an assistant.

General Remarks upon all Dislocations of the Hip.

After reduction has been accomplished in any of these cases, the legs should be tied together, and no movement allowed for at least two weeks. In some cases considerable inflammation about the joint may follow, which should be treated either with hot or cold applications, using water at the temperature which gives the

most relief. It sometimes happens that paralysis of the limb may follow a dislocation of the hip, owing to the pressure upon the large nerve which issues from the body through the sciatic notch, and which is called the *sciatic nerve.* Should this occur, a surgeon must be consulted, as this is a very unfortunate complication, the result being doubtful even under the best of treatment. It should be borne in mind that the reduction of a serious dislocation of this kind is one of the most important operations in surgery, and should the "*automatic*" method fail, all attempts to set the bone should be suspended until the services of a surgeon can be secured, even with a delay of a day or two.

Reduction is often impossible without the use of ether, and this, when practicable, should always be administered by a medical man, and besides this, serious injury to the soft parts, and even to the bone itself, may result from hasty manipulation or misapplied force. When, however, the patient is far remote from surgical aid, an intelligent friend may attempt his relief after studying carefully the description of the joint in the anatomical portion of this work, and then applying the rules here given for the detection of the displacement and for the methods of reduction. The operator should be satisfied that he knows where the head of the bone lies, and should then proceed to the proper manipulation in the gentlest possible manner, using the smallest degree of force that will accomplish the object. As heretofore suggested, do not be discouraged by one or six failures. Try again—always gently and without violence—and you may succeed.

As a rule, *old dislocations* should not be meddled with by inexperienced or non-professional persons, for the difficulties in the way of reduction are very great and not unattended with danger. A recent writer says that reduction may be safely attempted (by a surgeon) at any time before the end of the third week from the accident, but after that period even the best of surgeons rarely succeed. The dangers to be apprehended from ill-advised efforts to reduce an old dislocation are severe inflammation, destruction of the joint and fracture of the bone. Dislocation of the knee and rupture of its ligaments from excessive extension or pulling, has also occurred, with fatal results. This risk should never be incurred, as good movement has often been secured after attempts at reduction have failed.

Dislocations of the Knee-Cap ("Patella").

This bone is found in the tendon of the large four-headed muscle which covers the front of the thigh, and which is attached

to the large bone of the leg just below the knee. The office of this muscle is to lift and extend the leg, and the knee-pan covers and protects the front of the knee-joint, increasing, thereby, the leverage of the muscle. It may be dislocated outward, inward, or upward, or it may be turned up edgewise, so that one edge of the patella rests upon the joint behind it, while the other projects forward.

The *outward* dislocation is the most common on account of the traction outward of the strong extensor muscles. The accident results, usually, from direct violence or sudden muscular contraction, and may be either partial or complete.

Signs.—The *outward* dislocation may be recognized from the undue prominence of the inner condyle of the thigh-bone, which is partially covered by the patella when in its natural position, and by the patella itself being felt in its new situation. The knee is extended or slightly bent and immovable, and to the eye looks broader and flatter. This form is most frequently seen in women, in whom the lower ends of the thigh-bones point further inward than in men, and in knock-kneed, flabby persons.

In the rare *inward* dislocation, that is, when the knee-pan is forced by direct violence to its outer border toward the other knee—the outer condyle is most prominent, while the symptoms are much the same as in the outward form.

In *upward* dislocation the ligament which holds the patella is torn and, as a result, the bone is drawn upward by the contraction of the large muscle. It may be readily recognized by the position of the knee-pan above the joint.

Dislocation of the patella *edgewise*, or upon its long axis, as it is called, is produced by the same causes as lateral dislocation, and is easily made out as the bone is turned half way over, so that its outer edge (usually) lies immediately under the skin, forming a well-marked projection. The knee-pan is very firmly fixed in its unnatural position, and either edge may project, or it may be completely turned over, so that its hinder surface is in front. The leg is usually extended, or at most very slightly bent. Fortunately, this is a very rare form of the dislocation.

Formerly, a rupture of the large extensor muscle of the thigh above the knee was called a dislocation *downward*, but Hamilton asserts that in no case has the patella become displaced in this direction, in any other sense than that it remains stationary when the knee is bent.

Treatment.—In dislocation *outward* the patient should be laid upon his back on the floor, with the leg extended as far as possible. The operator then lifting the limb, places the heel upon

his own shoulder so as to relax the large muscle above the knee, and finally, with his hands, pushes the knee-pan into its natural position.

Dislocation *inward* may be reduced in the same manner.

Displacement *upward*, being the result of a rupture of the ligament, is to be treated as though it were a transverse fracture of this bone. (See **Fracture of the Knee-cap.**) The torn ligament usually heals after six or eight weeks, but, as in the case of fracture, is longer than natural. This, however, does not seriously impair the motion of the limb.

Dislocation *downward*, or rupture of the muscle, is also to be treated as a fracture by placing the limb upon an inclined plane with bandaging, as directed in the section upon **Fracture of the Knee-cap.**

In displacement *edgewise*, the patient is to be placed in the same position as in dislocation outward, with the heel of his extended leg resting upon the shoulder of the operator. Pressure in the direction we wish to carry the bone is then made with the fingers against the *upper* margin, while pressure in the opposite direction should be made against the *lower* margin with the rounded handle of a large door-key, or some similar implement. Should this fail, we may succeed by alternately bending and straightening the knee, while the pressure is still kept up. The last method will be more likely to effect reduction, if, while the manipulation of the joint and pressure upon the displaced knee-pan are continued, an assistant also makes firm pressure downward with both hands spread over the large muscles of the thigh, four or five inches, more or less, above the knee.

The knee-joint is so complicated and sensitive and so prone to take on inflammation, that it requires the gentlest handling. There should be as little delay as possible in reducing the displacement, and any careful person had better undertake it than wait too long for a surgeon. After the dislocation has been reduced, the patient should be placed in bed, with a splint of pasteboard, leather, or bark, under and at each side of the knee, and hot or cold applications be made until the inflammation has subsided. When this is effected the knee must be supported by a strong leather knee-cap, for a month at least, to give time for the ligaments to unite firmly. These dislocations are apt to recur, and it is safer to wear the protecting knee-cap for a year or more. Indeed some persons are obliged to wear them always.

Dislocation of the Semi-Lunar Cartilages of the Knee.

If the reader will refer to the anatomy of the knee-joint, he will see that the upper end of the large bone of the leg (*tibia*) has a flat surface upon which rest the two rounded protuberances (*condyles*), which form the lower end of the thigh-bone. To this flat surface are attached the crescentic or half-moon shaped (*semi-lunar*) cartilages—one at each side—and they serve to deepen this surface and form two depressions, one for each condyle. The outer borders of these cartilages are thick and rounded, while the inner borders are thin and hollowed. Each cartilage covers about two-thirds of its half of the flat surface, while the centre is not covered by the flattened ring of cartilage. In dislocation of one of these cartilages, a portion of it is torn by violence from its attachment to the flattened surface at the head of the large bone of the leg, and is either slipped forward or backward from beneath the prominence of the thigh-bone which rests upon it, or it may be doubled inward in such a manner as to wedge the bones which form the joint, and greatly impede motion. It generally happens to persons who have weak or relaxed joints, or in those whose knee-joints have been the seat of injury or inflammation, but it also sometimes occurs to the strongest and most robust. The inner cartilage is oftener displaced than the outer. It is generally caused by twisting the knee, by tripping over a stone, or other obstacle, while walking, or in rising from a kneeling posture. It has occurred from simply turning in bed.

Signs.—Whatever be the cause of the accident, the patient is seized at once by a sharp, sickening pain in the knee. This is at once fixed in a half-bent position, and any attempt at straightening the leg is followed by pain more or less severe. When the intense agony which accompanies the accident has subsided, a painful spot is left. If the cartilage is not replaced, inflammation and swelling of the joint will soon occur. The patient cannot stand upon the injured limb, and, if examined early, a depression may be found on the side of the affected joint.

Treatment.—This is one of the dislocations which especially demands the services of a surgeon, as its reduction is always difficult and sometimes impossible, without the use of ether. The patient should lie upon his back with the thigh strongly bent at the hip, and the operator should place one hand in the hollow under the knee and, grasping the limb with the other hand just above the ankle, should bend the knee suddenly and forcibly, and then rapidly straighten it, combining these movements with a

twisting outward and rocking motion of the joint. If the manipulation is successful the patient can move the joint at once. Sometimes, when all efforts at relieving the displacement have failed (and failures occur even to the best of surgeons), the patient himself has unconsciously replaced the cartilage by some accidental movement; he should, therefore, be kept in bed and allowed to move the limb but not stand upon it. When reduction has been effected the joint should be kept in a splint, and the almost inevitable inflammation be combated by means of hot or cold water applied with woollen cloths, or the application of leeches around the joint, and rest. The patient should afterward wear a laced or an elastic knee-cap, as this dislocation is very liable to recur.

Dislocation of the Knee-Joint.

The head of the large inner bone of the leg (*tibia*) which forms the floor of the knee-joint may be dislocated forward, backward, or to either side. In most cases the dislocation is incomplete, and complete displacements are usually either *compound*, that is, associated with the fracture of a bone, or *complicated* by an opening into the joint, or by extensive tearing of the soft parts. Dislocations of the knee are of infrequent occurrence, owing to the numerous and powerful ligaments by which the bones forming the joint are held in place. In the partial or incomplete dislocation, well directed and intelligent manipulation will usually effect reduction with comparative ease, but the services of a surgeon are absolutely essential in the complete form, as immediate amputation is often necessary.

These accidents may result from direct or indirect violence, such as twisting the thigh upon the leg by stepping into a hole while walking rapidly. The dislocation forward is usually occasioned by falls upon the foot while the knee is bent, or by some force which forces the lower end of the thigh-bone backward behind the head of the *tibia*. The writer once treated a case of this form in which the patient was twitched with great violence against a fence rail by a vicious colt he was leading, striking his thigh just above the knee-pan. The dislocation was nearly complete, and the ligaments and tendons were extensively torn. Twenty years have not sufficed to restore the integrity of the joint.

Signs.—These dislocations are readily made out by the peculiar deformity they display. In displacement forward the head of the lower bone (*tibia*) is pushed up and forward, generally presenting a somewhat twisted appearance. The knee-pan is drawn above

its natural position into the depression above the head of the tibia, and it can be lifted up with the thumb and fingers, as the large muscles upon the front of the thigh are much relaxed. The two protuberances upon the lower end of the thigh-bone are found in the ham, back of the knee, where they form two well-marked bunches. Sometimes so much pressure is thus made upon the large arteries that the circulation of blood is impeded in the top of the foot, and the patient complains of pain and numbness of this part. The leg may be somewhat shortened, the shortening being greater the nearer the dislocation approaches the complete form.

In the dislocation backward the head of the tibia is found behind the knee, forming a prominence easily recognized, while in front of the joint there is a large projection formed by the lower end or condyles of the thigh-bone. Below this we shall find the knee-pan with a strongly-marked depression upon each side, with its ligament and the tendon of the large muscle above the knee stretched tightly over the end of the displaced thigh-bone. The shortening (if any exists) is less than in the dislocation forward.

Sidewise or *lateral* dislocations are marked by a bony prominence at the inside or outside of the knee, according to the new position of the head of the bone. A depression exists in the natural situation of the knee-pan, while this bone itself is pushed to one side or the other. The limb is twisted, and there is an increase in the width of the joint.

Treatment.—As a rule these dislocations are replaced without much difficulty. In case of lateral dislocation, simply drawing down the leg (*extension*), aided by direct pressure in the proper direction, upon the displaced bones, is all that is required. In dislocations backward the knee should be forcibly bent while direct pressure is made by an assistant, and a rocking motion may also be imparted to the limb by the operator. In dislocations forward this manipulation should simply be reversed.

The after-treatment is very important, as great swelling and much inflammation are to be expected. The limb should be laid in a long box suitably padded, and hot or cold applications be made until the acute symptoms have subsided.

In the case mentioned above, the writer was indebted to an experienced old lady for a suggestion which gave the patient speedy relief, and which has often been used in other cases with equal success. It was to steep a quantity of "*Lobelia*" or "Indian tobacco," as it is called, and add to the infusion an equal quantity of rum or diluted alcohol. The knee was enveloped in cloths wet with this mixture, applied hot and changed when cool. The pain

and inflammation were controlled wonderfully soon. The addition of poppy leaves or heads to the lobelia is very beneficial in relieving pain. If the means are at hand it is more convenient to prepare this lotion by adding to half a pint of hot water four or five tablespoonfuls of the tincture of lobelia, and an equal quantity of laudanum. As the inflammation subsides, reduce the strength of the wash by adding a larger quantity of hot water, as, if too long continued, it may cause troublesome vomiting and depression of the system. As already suggested, this application has a wide range of usefulness, and can be applied to any swollen and inflamed joint where the skin has not been extensively torn.

After recovery from dislocations of the knee the patient should not be allowed to move or stand until the joint has been protected by an elastic knee-cap or a firm bandage.

Dislocation of the Head of the Outer Bone of Leg.

This is a very unusual accident, and is seldom seen except as a complication of more serious injuries of the knee. It may be displaced either forward or backward, and is generally the result of sudden and violent contraction of the muscles which are attached near the head of this bone.

Signs.—This dislocation is easily made out, as the head of the bone lies near the skin at the outside of the leg just below the knee. A very brief examination will enable one to decide whether it is out of place, and whether it is too far in front of, or behind its natural position.

Treatment.—According to Dr. Hamilton, it is most easily reduced by bending the knee and making direct pressure upon the head of the bone. A few thicknesses of cotton cloth, folded so as to form a compress three inches long and two inches wide, should then be placed over the head of the bone and secured by a bandage applied firmly enough to keep the bone in place. The same rules for combating inflammation apply here as in other dislocations of the knee, and the knee-cap should be worn as directed.

Dislocations of the Ankle.

Dislocations of this complicated joint are generally caused by jumping from great heights or from carriages in motion, and may occur in four directions, each of which is often complicated with fracture of either or both of the bones of the leg, viz. : the tibia and fibula. The displacements may be complete or incomplete,

but the latter form is most common, as complete dislocations are almost invariably associated with fractures. In simple dislocations the bones are forced either forward or backward, while dislocations inward or outward are accompanied by such extensive breaking of bone and tearing of ligaments, etc., that, strictly speaking, they should be considered and treated as fractures. (See Sections upon Fractures of Lower Extremity of the Leg and of the Ankle.)

By referring to the description of this joint in the chapter upon ANATOMY, it will be seen that the bone forming the lower portion or floor of this joint (the *astragalus*) is fitted into a sort of mortise formed by the bones of the leg. The lower end of the small outside bone of the leg—the fibula—laps over the astragalus considerably, while a projection upon the outer edge of the large bone points downward and is deepened by a rim of cartilage. The cavity or mortise thus formed is the socket in which the astragalus plays, protected by bone upon both sides, while in front and behind there is nothing but strong ligaments and tendons to prevent displacement.

Signs.—Dislocation of the foot *backward* is usually produced by a violent forcing of the bones of the leg forward while the foot is fixed, and is readily known by the shortening of the upper and front portion of the foot, with the toes pointing downward, while the heel is proportionately elongated and points upward.

Dislocation of the foot *forward* is a very rare accident, and it is generally incomplete. It is recognized by symptoms precisely opposite to those just described, as here the heel is shortened and the foot lengthened. In the latter form of displacement the upper surface of the artragalus may be felt by the fingers.

Dislocation of the foot *outward* is known to surgeons as "*Pott's*" fracture (see page 689), as the outer bone—the fibula—is generally broken two or three inches above the outer ankle-bone or the *external malleolus*. It is caused by sudden and forcible turning of the foot outward—the outer edge of the sole being raised and the inner edge turned downward toward the ground. There is a depression at the lower end of the outer bone, and a corresponding prominence upon the other side of the leg caused by the displacement of the inner bones. There is always a fracture of one or both bones.

Dislocation of the foot *inward* is the counterpart of outward dislocation, but with the symptoms reversed—for in this the force that twists the foot inward turns its outer edge to the ground. The lower end of the inner bone is generally broken off. The tibia being a much larger bone than the fibula, the force required

to produce the dislocation is very great, and consequently it is more rare.

The fibula is frequently fractured and drawn outward with the astragalus against which it rests. The accident may be recognized by the prominence of the outer bone of the ankle, and by the sole of the foot looking directly inward.

The *last* form of this dislocation is of very rare occurrence, and yet should be mentioned to prevent possible confusion in diagnosis. This is a displacement of the bones of the leg at their lower extremities, in which the tibia and fibula are forced apart, and the astragalus driven up between them. It is usually produced by a fall from a considerable height, and upon one or both feet. The ankle bones (*malleoli*) are widely separated, the depth of the foot from the lower edge of the ankle to the ground is lessened, and the movements of the foot are nearly lost. This form may exist without fracture. These dislocations frequently result in permanent stiffness of the ankle, and a perfect recovery is a rare exception to this rule.

Treatment.—In most cases these dislocations may be replaced by extension and well-directed pressure. Sometimes it may be found necessary to bend the leg strongly, and then make proper manipulation. The lower extremities of the leg bones and the foot may be pressed forward or backward, according to the direction of the dislocation. The swelling and inflammation which follow the accident must be treated by hot or cold applications, etc., as directed for the after-treatment in dislocations of the knee. To prevent a recurrence of the displacement, the joint should be supported by light pasteboard or leather splints until the inflammation and swelling have subsided, when a starch, or starch and glue bandage should be applied. Reduction of lateral dislocation is usually easy, as the bones can be moulded into place by careful manipulation. In these cases, if the limb can be saved at all, it must be treated as a fracture—either simple or compound—and to avoid repetition, the reader is referred to the section upon the Treatment of Fractures of the Leg.

In compound or complicated dislocations of the ankle, a question as to the necessity of amputation will always arise, and there should be no delay in procuring the services of a surgeon, as the life of the patient often depends upon his decision and prompt action. In these injuries, as in those of the knee, nothing but the greatest emergency can justify a non-professional person in an attempt to treat them.

Dislocations of the Bones of the Foot.

The bones of the foot are separated by anatomists into three divisions, and are designated collectively, the tarsus, metatarsus, and phalanges. The first class mentioned does not strictly belong to the foot, but bears the same relation to it that the wrist or *carpus* does to the hand. The bones of the *tarsus* are seven in number, and lie directly under the bones of the leg forming the entire back portion of the foot. The *astragalus*, the upper bone of this division, which with the bones of the leg forms the ankle-joint, is occasionally dislocated forward or backward, both from the bones of the leg above, and from the other bones of the tarsus beneath. These injuries are caused by falling with great force upon the feet, or by jumping from a carriage or a railway car when in rapid motion. Dislocations to one side or the other also occur, but are associated with fracture of the bones of the leg, and sometimes of the astragalus itself.

Signs.—In displacement forward, the leg may be somewhat shortened, the astragalus projecting in front of one or the other ankle-bones (*malleoli*), while the foot is thrust forward and twisted to the opposite side. In the backward dislocation the foot is much bent, the heel elongated and the instep shortened. Dislocation of the foot from the astragalus may be known from the turning inward or outward of the foot, the prominence near the instep, and the absence of crepitus.

Treatment.—In simple dislocation reduction may be attempted by making firm traction, the leg being bent upon the thigh, and by rotating and twisting the foot in the opposite direction to that in which it is found, while firm pressure is made upon the projecting astragalus. Should these efforts fail after repeated trials, and no surgeon be at hand to divide the heel-cord and thus effect reduction, the patient should be kept upon the bed and inflammation kept down or relieved by proper applications. With great care he may thus recover a fair use of the foot, and even if destruction of the soft parts or of the displaced bone does occur, it gives time to secure the attendance of a surgeon who may save the foot by removing a portion or the whole of this bone.

Dislocations backward are usually irreducible, but a very useful foot often results if the patient is willing to submit to a long but necessary confinement. Compound dislocations absolutely require surgical aid, as the bone itself must be removed or the foot amputated, or destructive inflammation, pus-poisoning, or lockjaw may result from the want of heroic treatment.

Other Dislocations of the Tarsus.

Other dislocations of the tarsal bones may occur either singly or two or more together. The heel-bone, or *calcis*, and the *scaphoid* may be twisted from their junction with the astragalus, and the *cuboid*, the *cuneiform* bones, and the *scaphoid* may also be displaced, either separately or together.

For a description of these bones and their situation in the foot, the reader is referred to the appropriate section in the anatomical portion of this work. A knowledge of the natural position of these bones in a healthy foot will enable any one to make a correct recognition of the nature of the displacement, but the operator should be careful not to mistake an inborn deformity or thickening of the bone-skin (*periosteum*) from disease for a dislocation.

Treatment.—Replacement in these cases may generally be accomplished by pressure and traction, or twisting in different directions according to the nature of the particular displacement. Even if not successful in the manipulation, the foot will often be serviceable in spite of the deformity. This, to the writer's own knowledge, is true of a dislocation of the *scaphoid* bone.

Dislocation of the Metatarsal Bones.

These bones are situated between the tarsal bones behind and the bones of the toes in front, and are rarely dislocated except as the result of great violence, when amputation of a part of the foot will be required. In one case all the metatarsal bones were wrenched from their attachments to the cuneiform and cuboid bones and thrown above them, where their bases could be seen and felt. All efforts at replacement failed, but a good foot was secured eventually. Single bones in this locality have been dislocated, but so rarely as to require no comment, as reduction can only be effected (if at all) by traction, twisting, and pressure. In any event the foot should be supported by suitable splints for a proper length of time ; and in none of the accidents above mentioned should there be any delay in securing the aid of a surgeon, if it is possible to do so.

Dislocation of the Toes.

Dislocations of the bones of the toes are exceedingly rare, being much less common than those of the fingers. They are usually displaced upward by some force applied to the ends of the toes, and are generally associated with fracture. The great toe, from its exposed situation, is the one usually dislocated, and, as in the

thumb, great difficulty is sometimes experienced in effecting reduction. The same rules apply here as in the case of the thumb, and reduction may be attempted in the same manner. If tilting the toe upward so that it stands erect, and then pushing the base of the toe over the rounded end of its corresponding metatarsal bone does not restore the joint, strong traction and bending, with well-directed pressure, may be resorted to.

A. B. CROSBY, M.D.
H. H. CROSBY, M.D.

Bruises.

A blow falling upon any part of the body causes a rupture of the veins and arteries of the parts, and from these vessels the blood is poured out into the tissues. If the vessels ruptured are large or numerous, and the tissues loose, the quantity of blood poured out of the vessels into the tissues will be greater than when only small or few vessels are ruptured in dense tissues. Immediately following such a rupture of veins and arteries, a circumscribed swelling will occur, and soon the blood will come so near the surface as to give the skin a dark or "bruised" appearance.

Bruises are more or less painful as they occur in the more or less sensitive parts of the body. Thus a bruised finger or lip will be very painful, while a similar injury of other parts may be less so. The swelling and discoloration resulting from bruises are not always most marked at the site of the injury, for the blood, to the accumulation of which discoloration and swelling are due, may be prevented from coming to the surface at a point opposite the injury, but may be made to pass to some distant point by the resistance offered by broad tendinous tissue. If a blow falls obliquely upon the surface, the outer skin (epidermis) is removed from the more resisting true skin beneath, and if it is not immediately separated, it is presently lifted by the accumulation of blood or bloody serum under the epidermis, forming a "blood blister." Some hours after a bruise has occurred the margin begins to become thick, hard, and painful; this is due to the occurrence of inflammation at this line.

Treatment.—The treatment of bruises must be determined by the conditions. In the very beginning, while yet the blood is flowing from the vessels into the tissues, it is desirable to check the flow, and this is best done by cold, as ice, cold water, or cold air; by keeping the part wet with a spray of sulphuric ether, rhigoline,

benzine, or any other liquid that evaporates rapidly. [This must be done at a considerable distance from an open fire or light, as the vapor of these liquids is very inflammable.] By applying the hand at once to the part upon which a blow has fallen, and making firm pressure for half an hour, the flow of blood may be prevented; or a bandage may be snugly and neatly applied ; but this must not be allowed to remain more than thirty minutes, if tightly applied. The hand is safer and better. By elevating the bruised part, the flow of blood into it is retarded, and the quantity poured out into the tissues diminished. In case of bruises about the face, it is sometimes especially desirable to prevent discoloration ; here cold may be applied at once, and pressure by the hand. A common and very objectionable practice in these cases, is to apply leeches, with the hope that they will draw out the "bruised blood." On the contrary, they not only do not draw out the effused blood, but are sure to leave marked discolorations at the site of each bite. At this period leeches can do no possible good, but always do harm. Perfect rest is also valuable in preventing the large accumulation of blood, and this should always be practised.

It sometimes happens that the flow is so abundant as to cause, by the rapid withdrawal of a large quantity of blood suddenly from the circulation, considerable faintness. In such cases the head should be placed on a level with the body, or the trunk may be kept in an inclined position above the head. When a large accumulation occurs, some persons are tempted to withdraw it from its abnormal site by a pump and small tubular needle (aspirator), lest if it remain it should putrify. This is always bad practice, since large quantities of blood thus occupying the tissues are again taken back into the blood-vessels ; and besides, the process by which it is proposed to remove the fluid is much more likely to lead to, than prevent putrefaction.

In case of large accumulation of blood, there will be of necessity a breaking down of the tissues by the mechanical pressure of the blood, with stretching and narrowing of the blood-vessels that pass through and about the accumulation, and this will diminish the blood supply to the bruised tissues. Now if, to this diminished circulation, the depressing influence of long-continued cold be added, there will be danger of mortification, so that as soon as the blood-flow into the tissue is checked, the part may be left exposed; and if the temperature of that surface is below the normal temperature, the part should be covered by dry or wet warm cloths, or bottles of warm water should be kept near it. After a few days it may be found that the patient has fever, and that the temperature of the bruised part is greater than in health and is painful

and tender; in other words, there is inflammation. Now evaporating lotions, as lead-water, pure water, vinegar and water, tincture of calendula, tincture of arnica, or alcohol and water [see Formulas] may be applied and cooling drinks given, and a dose of Epsom salt administered.

This inflammation may result in the formation of matter, or putrefaction may occur. In either case the whole of the fluid should be discharged by a free incision, and if the material discharged should be offensive, the cavity should be washed out once or twice a day with a solution of carbolic acid, boracic acid, or alcohol and water. This procedure requiring, of course, the aid of a surgeon; and this should be continued until the matter ceases to be offensive. If, on the contrary, the swelling remains for several days or weeks without inflammation or putrefaction, the application of hartshorn liniment, or some other stimulating substance, may aid in its disappearance. In the disappearance of the dark discoloration, the dark blue or purple assumes a greenish orange and finally a light lemon color.

In every case of severe bruise, after the application of cold and pressure, the family physician should be called in to take charge of the patient and relieve the family of what may be a grave responsibility.

Convulsions

may depend on improper food ; in such cases an emetic should be administered.

A teaspoonful of powdered alum dissolved in half a glass of cold water, or the same proportion of ground mustard and warm water, will act quickly and efficiently. Most cases of convulsions cannot, by the friends, be traced directly to a cause, hence it is important to call a physician, and until his arrival, the patient may with safety be put in a warm bath or wrapped in blankets wrung out of hot water ; and in all cases in which the face is flushed, cold water should be applied to the head.

If very violent, the patient should be placed on a large bed, and the movements restrained, so that the body and limbs shall not be bruised or cut. Especial attention should be given to the tongue, as this is liable to be severely bitten. The handle of a table-knife, a cork, or bit of wood, should be held between the teeth at the corner of the mouth until the convulsions cease.

In cases of females over 12 years of age, it is always safe to administer a tablespoonful of tincture of assafœtida [mixed with half a glass of water, and in case this cannot be swallowed, it may be injected into the bowel by means of a syringe].

Smothering—Choking, Strangling, Drowning, Suffocation by Drowning, Hanging.

The condition expressed by these terms is that in which the breath is stopped, and will be indicated by the starting eye, the livid lips and face, the expression of terror presented by the countenance if the patient be seen before consciousness is lost. In this stage, as in that which follows, the important matter is to remove the conditions that gave rise to the obstructed breathing. Loosen the deadly grip from the throat, cut the strangling cord, drag from the water, remove from the suffocating gases. A later stage presents itself when all struggling has ceased, when the features are expressionless, when the glare of the eye adds nothing to the expression of terror, and when the history and surroundings almost indicate the cause of the condition. If in any case the body is yet warm, an effort should be made to revive the patient, and *one should bear in mind that the time is indefinite during which none of the usual expressions of life are present, and yet a spark of life may remain and may be made to glow in the entire body.*

Treatment.—If the case be one of drowning, the head should be placed low, the body for a moment turned on the face, the abdomen compressed by being placed over some prominent body—a barrel, a stool, the edge of a boat, the knee, or anything that will make pressure while the body is on the face. After the water that readily discharges in this position has escaped, begin a process that is equally applicable in every case of obstructed respiration: place the patient on his back, let the head hang over the end of a bench or bank of earth, stand above the head, seize the arms below the elbows, draw the arms steadily and firmly above the patient's head, hold them there firmly for two seconds, carry the arms down so that the elbows rest against the sides, and press the arms below the elbows on the upper part of the abdomen. As the arms are held above the head, the air will be heard to rush into the lungs, and as the abdomen is pressed by the arms the air will rush out of the chest ; and this manœuvre should be executed fifteen or eighteen times a minute.

This should be kept up during ten minutes, and now some one, not excited, should place his ear over the heart of the patient, and should the sound of the heart be heard, the artificial breathing should be kept up until the patient breathes regularly and sufficiently. If, in the beginning of this artificial breathing, the blueness is observed to become less, there is reason to hope for final success.

Children and even grown persons are choked by masses of food or while laughing—a bean, a button, a bead, a pebble, a grain of corn, a coin, or some other body may get into the throat and choke the patient. The head should be held low with the face downward; the finger is made to search the throat and remove the foreign body if found. The body may be violently shaken, and in case the offending body be one that may pass into the windpipe, the finger should be pressed on the Adam's apple while the patient is coughing, and not infrequently it will be ejected. In any case, if the patient is not relieved at once, a physician should be called.

Howard's Method of Treating the Drowned.

The following method, introduced by Dr. Benjamin Howard, of New York, has been for some time in use by the N. Y. Harbor Police, and was awarded a prize by the American Medical Association:

"Rule 1.—Upon the nearest dry spot expose the patient to a free current of air; rip the clothing away from the waist, and give a stinging slap upon the pit of the stomach. If this fails to arouse the patient, proceed to force and drain away the water which has entered the chest and stomach, according to Rule 2 (Fig. 338).

Figure 338.

"Rule 2.—(Fig. 338.) Turn the patient upon his face, the pit of the stomach being raised, upon a folded garment, above the level of the mouth. For a moment or two make steady pressure upon the back of the stomach and chest, and repeat it once or twice until fluid ceases to flow from the mouth.

"RULE 3.—(Fig. 339.) Quickly turn the patient upon his back, with the bundle of clothing beneath it so as to raise the lower part of the breast-bone higher than the rest of the body. Kneel beside or astride of the patient, and so place your hands upon either side of the pit of the stomach, upon the front part of the lower ribs, that the fingers fall naturally in the spaces between them, and point towards the ground. Now grasping the waist, and using your

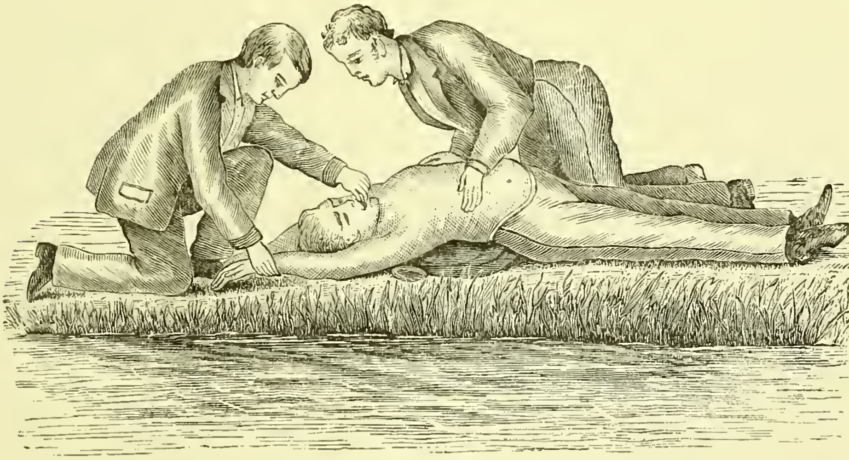


FIGURE 339.

knees as a pivot, throw your whole weight forward as if you wished to force the contents of the chest and stomach out of the mouth. Steadily increase the pressure while you count one, two, three, then *suddenly* let go, with a final push which springs you to an erect kneeling position. Remain erect upon your knees while you count one, two, then throw your weight forward and proceed again as before. Repeat the process at first about five times a minute, increasing the rate gradually to about fifteen times a minute, and continue it with the regularity of the natural breathing which you are imitating. If another person be present, let him with the left hand hold the tip of the tongue out of the left side of the mouth with the corner of a pocket-handkerchief, while with the right hand he grasps both wrists and pins them to the ground above the patient's head.

"**After Treatment.**—When breathing first returns, dash violently a little cold water occasionally in the face. As soon as breathing has been perfectly restored, strip and dry the patient rapidly and completely, and wrap him in blankets only. Give hot brandy and water, a teaspoonful every five minutes the first half-hour and a table-spoonful every fifteen minutes for an hour after that. If the

limbs are cold, apply friction. Allow abundance of fresh air, and let the patient have perfect rest.

"PRACTICAL SUGGESTIONS—WHAT TO AVOID AND PREVENT.

'*Avoid delay.*—Promptness is of the first importance. A *moment* lost may be a *life* lost. Waste no time in gaining shelter. When gained, it oftener harms than helps the patient.

"*Prevent crowding around the patient.*—However difficult this may be, it *must* be enforced. Friends must not be allowed to obstruct the circulation of air, nor to engage the patient in conversation when rallying.

"*Avoid attempts to give stimulants before the patient is well able to swallow.*—It helps to obstruct respiration, and may choke the patient.

"*Avoid hurried, irregular motions.*—The excitement of the moment is almost sure to cause this, in inexperienced hands. Just as a flickering candle moved carelessly goes out, so the heart, when its beating is imperceptible, needs but little cross-motion or interruption to stop it. The movements of Rule 3 should therefore be performed with deliberation and regularity.

"*Avoid an overheated room.*—The animal heat which is needed cannot be supplied from without, but must be generated within the system. This is best promoted by a free supply of cool air and internal stimulants. The vital heat resulting is best retained about the patient's body by blankets alone.

"*Avoid giving up the patient too soon to death.*—At any time within one or two hours you may be on the very threshold of success, though no sign of it be visible. Several times success has been known to follow half an hour's apparently useless effort. Rest and watchful nursing should be continued for a few days after resuscitation, or various chest troubles may ensue."

[Revival of Still-born Infants.

Reference has been made on page 427 to a condition of apparent death which sometimes occurs to infants at the time of birth, and which is caused by too long-continued pressure on the cord, producing suffocation. It must be remembered that the infant, before its birth, derives its oxygen from the blood of the mother, through the medium of the placenta and the blood-vessels contained in the navel-cord; and that so long as this circulation of blood continues, there is no need for it to make movements of res-

piration. Indeed, its lungs contain no air, and the amount of blood circulating in them is small. When the infant is born, and its connection with the mother ceases, it then commences to breathe and make use of its lungs, instead of the placenta, as its source for air-supply. When the flow of blood from the placenta has been arrested previous to the birth of the child, inspiratory efforts take place before it has passed out from the maternal cavities, and the consequence is that its air-passages become more or less filled with the fluids which are in contact with its mouth and nose ; and it is, practically, in the condition of a drowned person, and needs to be treated according to the foregoing directions.

When an infant does not breathe almost immediately after its birth, if its surface is red or dusky, and colder than natural and its lips blue ; if the eyes protrude ; its heart-beats feebly (as shown by the pulsations in the cord), and the cord is distended with blood, the following things should be done without a moment's delay :

Lay it face downward with its head low, and press its chest so as to force out any mucus that may be in its windpipe , clear out its mouth with a little finger covered with a layer of a sheet or soft napkin. Then turn it over and blow strongly into its face and spank its buttocks. These shocks to the surface will often cause it to breathe if the case is not a very serious one.

If it still remains motionless and its face is very swollen and dark, one or two tablespoonfuls of blood may be allowed to flow from the cut end of the navel-cord, while two dishes containing cold and quite warm water are being brought. As soon as possible dip the child into the warm water for a moment, and then into the cold—doing it quickly—and repeat this several times at intervals of a few seconds. This should be continued for two or three minutes. If, at the end of this time, the infant still does not breathe, cover the mouth of the child with a piece of thin stuff of any kind—a handkerchief, sheet, or napkin, and while its nose is held with a thumb and finger of one hand, and the pit of its stomach is pressed in with the other, let the operator fill her lungs with fresh air, and apply her lips over the covered mouth of the infant and gently blow air into its lungs. The nose is held to prevent the air escaping in that direction, and its stomach is compressed to prevent it, instead of the lungs being filled with air. This may be repeated several times.

Instead of this method, precisely the same movements of its chest may be made as are described in the foregoing pages, for the revival of drowned persons.

After it commences to breathe, it should be wrapped in a warm blanket, with its face uncovered, and it should be closely watched.

If its breathing ceases, blowing into its face or slapping its chest with the corner of a wet towel, will set it going again.

Until the child breathes regularly and has *cried*, no attempt should be made to wash or dress it.—Ed.]

[Swallowing Foreign Bodies.

When foreign bodies like coins, buttons, or marbles, etc., are swallowed, they usually pass, without difficulty, into the stomach, and it is not often that they cause trouble or fail to be passed from the bowel in the course of a day or two. It may be well at the outset to give an emetic of a teaspoonful to a tablespoonful of syrup of ipecac, or five to twenty grains of powdered ipecac or alum mixed with water; but if there is no food in the stomach at the time, such treatment is not likely to cause the expulsion of the object. It is well in such a case to give a meal of "hasty-pudding," bread and milk, oatmeal, or something similar, before administering the emetic.

If the emetic treatment does not succeed, it is well to see that several hearty meals are taken, so that the intestines will be distended and the foreign substance will not be caught in any of its folds. This is particularly desirable, when the object swallowed is sharp or has prominent corners, like pins, needles, bits of oyster shell, etc. The writer would suggest baked beans and tapioca pudding, calve's-foot jelly and coarse hominy, as suitable articles to include in such a dietary.

Remember Dr. John M. Francis's advice to a mother when, in great trepidation, she brought to him her little son who had just swallowed a quarter of a dollar: "If she was sure the coin was a genuine one, she must give herself no trouble, for good quarters would always pass."—Ed.]

Rupture—Hernia.

A part of the contents of the abdomen sometimes escape from that cavity through the imperfectly closed passages left in its wall in the process of development, so that we sometimes find children born with rupture at the navel or in the private parts. These ruptures are also many times made to appear from straining, as in crying, coughing, or at stool, or in lifting heavy weights, or indeed from any violent exercise. They may be recognized by the impulse communicated to them in coughing or sobbing, and if not strangulated (strangled), are not painful, but require attention,

since they may at any moment become imprisoned or strangled, and this is a condition of very great danger. Hernia may be confounded with hydrocele (water in the sac containing the testicle in the male, or the canal containing the round ligament of the uterus in the female).

If a patient have hydrocele and the canal still remains open, reaching to the cavity of the abdomen (as is generally the case in infants), the water may be made to pass back into the belly by placing the patient on the back and making gentle pressure on the swelling; and the last of the swelling that disappears will not suddenly slip from the fingers, but gradually and insensibly depart, while in case of hernia the last bit will be observed to slip suddenly, as a mass, from the fingers.

In older subjects, if the veins of the scrotum be large, the enlargement may be mistaken for hernia; the blood will flow out of these large veins if pressure be made on the swelling; or, if the patient lie on his back with the hips elevated, the tumor will gradually disappear; but on assuming the erect posture, the tumor will present itself not descending as a mass from the upper to the lower part of the sac, but by gradually filling the lower part first, and this last will be true also of hydrocele. Again, if a strong light be put on the opposite side of the hydrocele from the observer, the light will shine through it, looking like the hand when it is held between the eye and the sun.

If a hernia becomes strangulated, the patient suffers more or less pain as the part may be tightly or loosely bound; the pain is not only in the tumor, but in the belly as well, and the patient may be supposed to have colic; hence it is important that in every case of colic the regions in which ruptures occur should be examined to learn if a rupture exists. In strangulated rupture, vomiting and great prostration occur, and if the strangulation continues long, the matter thrown up from the stomach is feculent and more or less offensive—smelling like the passages from the bowels.

I desire particularly to call attention to the very great danger incurred in allowing ruptures to remain down, and urge that a competent physician be called at once—in every case.

Treatment.—Before the arrival of a physician it will be proper to place the patient on the back, elevate the feet, leave the head low, and make gentle pressure on the part, and if it returns and the patient is relieved, a pad should be placed over the point from which the rupture escaped, and a firm band fastened over it so as to keep up continuous pressure. No time should be lost in securing a well-fitting truss to be worn while the patient is not in bed.

It should be remembered that a truss to be of value must fit ac-

curately, and this adjustment can be attained only by one accustomed to adjusting trusses. Hence it is unwise to send measurements to instrument-makers, hoping to have a well-fitting truss returned. A bad-fitting truss can do no good, and may delude the wearer with a false sense of security.

If, in the absence of a physician, the friends have not succeeded in returning the part by the means suggested, the patient should have a soothing potion of fifteen to twenty grains of chloral, or one to two grains of opium, or twenty-five to forty drops of laudanum (or paregoric, if a child) in water, and cold applications should be made to the part. If ice is used, several folds of flannel should be placed on the skin to protect it from intense cold. The surface thus covered should be inspected every half hour, and if it appears of an ashy whiteness, the cold must be less actively applied. If, after a sound sleep of several hours, the tumor remains, another attempt should be made to replace it by gently pushing it toward the opening through which it escaped; but it is far better that a physician be called at once, if possible, and that he take charge of every case of strangulated hernia.

In case of infants having hernia at birth, or, indeed, at any period, if a physician is not consulted, a loosely wound ball of woollen yarn as large as a small egg, covered with soft linen, may be placed over the opening and held in position by a well-adjusted diaper. Of course the tumor must be returned each time before the pad is applied. In case of hernia at the navel in infants, when the tumor is replaced, a little opening may be felt in the wall of the abdomen. A piece of cork may be made in the shape of half a ball, a little larger than the opening and covered with linen, and this may be held in position by a strip of adhesive plaster (rubber plaster is best) long enough to reach two-thirds the circumference of the body. It should be twice as broad as the cork pad, and the centre should be placed on the pad and the two ends carried around the body toward the spine; or the pad may be held in position by the band usually applied to young children.

The hernias of young children, if kept in position, are generally cured, and nothing will more certainly secure this desirable end better than the intelligent use, by an attentive mother, of a well-devised, faithfully applied truss.

In closing this section, let it be fully understood that the measures here recommended are only, in any case, to be used until the services of an intelligent physician can be had.

Sprains.

This term is applied to conditions most usually occurring about joints, and consisting in a straining or tearing, to a greater or less degree, of the ligaments. They rarely exist of great severity without being complicated by injury of parts actually forming the joint. The sudden swelling and discoloration that follows a strain are the result of the pouring out of blood from torn vessels into the tissues under the skin. The violence done to the parts may vary almost infinitely—from that which gives only a momentary twinge of pain, and furnishes no other evidence of injury, to that which may be unbearably painful and result in permanent disability of the joint. The tissues injured in strains are of low vitality, and are very slowly repaired; hence much time is required for complete restoration of form and function.

Strains result from over-bending of joints or by bending them in a direction not provided for in the mechanical arrangement of the parts forming the joints. Any one stepping on an uneven surface may turn the foot too far inward or outward, or, falling on the hand, may bend the wrist too far backward or forward.

A strain will be more or less dangerous to limb and life as the joint may or may not be one whose use can be suspended with much or little discomfort. The general conditions of the system, as being favorable or unfavorable to the repair of injury, exercise an important influence in the healing of strains.

Treatment.—The most valuable means of treating a strain is *rest*, ABSOLUTE REST of the part. A strained back cannot have rest unless the whole body rests; this is likewise true of a strain of the hip. In both cases the patient should be placed on a smooth hair mattrass, and kept there until the part has absolutely recovered, and this may be known to have occurred when the usual movements may be made without pain.

In strains of the knee, ankle, elbow, wrist, or finger joints, rest may be secured by well-adapted and perfectly fitting splints ; and these splints are valuable only as they secure rest ; and those splints are most efficient that are adjusted to the largest extent of surface. Hence long splints that are moulded to the part are the most valuable. In the very beginning cold applications are best; after a few hours warm or cold, as may be most grateful to the patient.* After the acute pain has ceased and the inflammation has

* [It is customary among many acrobats, ballet-dancers, and athletes, to treat their sprains from the commencement with fomentations of water as hot as can be borne in comfort, and this is continued if possible for an hour. Following this, a tightly fitting and elastic bandage is applied and carefully watched to prevent any harm that might come from swelling of the injured part.—ED.]

subsided, when there remains stiffness, with perhaps swelling, dry frictions, or frictions with stimulating oily liniments, kneading of the part, and motion made by the hands of an attendant, will be most efficient means for restoring the normal suppleness of the joint.

If the joint can be moved freely by the hands of an assistant without pain continuing afterward, it may be known that the joint is not inflamed and that motion is admissible and beneficial; but if pain lingers after such movement, it will result only in harm.

If the swelling which occurs immediately after a sprain is strictly limited to the joint, it may be known that blood has been poured out into the joint. If, on the contrary, the swelling extends beyond the joint, blood may also be about the joint as well as in it, and both cases require the most careful treatment by a physician. Strains of the hips are apt to lead to hip-disease, while strains of the back, in children, are frequently the beginning of hunchback. Too great care cannot be taken in either case that the child is thoroughly well before it is permitted to resume active exercise.

In every case of sprain in which the pain continues more than a day or two, a physician should be called; and in every case in which the pain is intense or the swelling marked, a physician should see the patient at the earliest possible moment.

Rupture of Veins and Aneurisms.

It is not likely that either of these accidents will come upon a person unaware of the proper manner of controlling the bleeding when it is possible to do so, since a physician has probably been in attendance and has given the needed instruction. It may be said, however, that the same directions may be followed in such cases as apply to bleeding from wounds, for which see page 592.

Injuries of the Head.

This title embraces every grade of injury.

If the injury be due to a fall, the head striking on or receiving a blow from some solid object, the skull may be broken, or the brain may be severely jarred, so that the patient remains insensible for a time. In every case of this kind, or in any case followed by delirium or pain in the head, a physician should be called at once.

If there be simply a cut in the scalp or face, with bleeding, the blood may be stopped by pressing the finger on the bleeding point until a physician arrives. When the bleeding has ceased, the

parts should be cleaned of dirt, hair, or whatever else may be on it; and if the edges come easily together, they may be efficiently dressed by a compress made of soft old linen folded and bound on the part; or, after shaving the scalp, strips of fine gauze may be laid at right angles to the cuts, from one side of the wound to the other, and while held by the fingers collodion may be applied; or the edges may be held together, and a thin layer of the long fibres of cotton-wool may be applied and moistened with compound tincture of benzoin. The benzoin should be allowed to dry after one or two applications. After any of these dressings the parts should not be disturbed until all soreness is gone or matter forms; and in the latter case when the dressing is removed, it should be substituted by some simple ointment Stitches should be avoided in the scalp, and this may usually be accomplished if the hair is shaved and the treatment as above directed is followed.

The lips of wounds about the face cannot so readily be kept in position by plaster or collodion, because of the many concave surfaces, and because of the great number of muscles that pass in different directions, and are little under control and liable to be brought into action by the emotions; hence stitches become necessary. This is especially true of wounds of the lips, nose, ears, eyelids, and eyebrows. In all these cases great care should be exercised in securing precision of adjustment.

The treatment of these cases will require the best skill of the surgeon to prevent deformity. Wounds about the face caused by an instrument covered with soot or coal-dust, or by the near explosion of powder, are sure to leave a black scar, unless the edges blackened by the carbon and the grains of powder are removed.

Every wound of the eyeball demands the early attention of a surgeon.

Wounds of the tongue, in which the edges do not remain in contact, demand the attention of a surgeon; so, also, do wounds of the palate, if they involve the free margin.

Apoplexy.

A bleeding on or into the brain may occur at any period of life, most frequently after forty, and may take place in the lean or fat, long or short, thin or thick, empty-blooded or full-blooded, without or with excitement, during sleep or in the activity of waking hours. In short, apoplexy may occur in persons of any temperament, at any time, and under every conceivable combination of circumstances.

The full-chested, large-headed, and short-necked, are not more liable than the chicken-breasted, bullet-headed, and long-necked,

since all are equally liable to he disease of the walls of the blood-vessels which, by their rupture, are the source of the accident. It is sometimes preceded by flashes of light, hearing of sounds that do not exist, a sense of insects crawling on the limbs or body, a loss of memory. Persons having these premonitions should avoid physical or mental excitement, and should eat and drink with moderation. If the attack is violent, the patient falls insensible, with slight convulsion or without, and may be profoundly insensible, or may be aroused to partial consciousness. Vomiting may be a symptom.

Treatment.—If the heart is acting strongly and the face is flushed, the head should be elevated and the patient bled, and cold applied to the head. If the heart beats feebly, the head should not be raised. Stimulants, as wine, ether, or brandy, may be given in small quantities. The greatest possible freedom from excitement should be enforced. A cool, dark, silent room should be provided. Rest should be the motto.

Patients frequently recover from apoplectic attacks with or without paralysis.

A physician should be in attendance in every case.

Lightning-Stroke

varies in its intensity, from that resulting in instant death to that which resembles the passage of a feeble electric current through the body.

Fracture of bones, rupture of blood-vessels, muscles, nerves, tendons, and skin, trifling or extensive burns, deafness, blindness, more or less paralysis, all result from "lightning-stroke." Where animation is suspended from "lightning-stroke," artificial respiration, as described in chapter on Drowning, should be resorted to (the head being kept low), and this should not be abandoned during the first half hour. A dash of cold water may excite breathing. If the patient breathes, but is feeble, absolute rest and perfect quiet should be maintained, gentle stimulants administered; and the temperature should be kept up by artificial means, such as hot blankets, bottles of hot water, hot bricks, etc.

The injuries remaining after recovery from the shock should be treated without reference to the causes, by a competent physician.

JOHN T. HODGEN, M.D.

Poisons: Their Effects and Antidotes.

BY

ALBERT B. PRESCOTT, M.D., F.C.S.,

OF ANN ARBOR, MICH.,

PROFESSOR OF APPLIED CHEMISTRY IN THE UNIVERSITY OF MICHIGAN, ETC., ETC.

POISONS: THEIR EFFECTS AND ANTIDOTES.

MAN is never secure from danger of poison. In selecting his food, in finding material for his art, in applying remedies for disease, he may at any time admit an enemy to his life. In primitive society there are the poisons bred in the rankness of nature; in civilized society there are others made in the prodigality of invention. This paper was made with help of poison, the ink contains poison, the type may become poison. It indicates a good degree of vigilance that so few persons are poisoned outright.

By the United States Census of 1870, the number of deaths from poisoning, both accidental and chronic, in one year, was stated to be 1,752, or nearly five per thousand of the whole number of deaths,—cases of suicide and homicide by poison not being included. The census of 1860 reports 943 deaths by accidental poisoning alone, for one year, this number being 2.4 per thousand of total deaths. In England, there were published in the Pharmaceutical Journal for 1876, 80 cases of sudden poisoning, of which 65 were accidental, 12 were suicidal, and 3 homicidal. In 36 per cent. of these eighty cases the poisons consisted of articles used in the industrial arts, or of impure food or substances mistaken for food. In 64 per cent. of the cases the poisons were mistaken for medicines, or were simply medicines misapplied. Six per cent. of the cases resulted from mistakes in the preparation of medicines. Of the eighty sufferers, 6 were poisoned with carbolic acid; 8, with chloral hydrate (7 of these being in habitual use of the article); 5, with "children's cordials" (all infants); 6, with cyanide of potassium; 11, with laudanum (7 being instances of suicide); 4, with vermin-killers (all suicides); and 1, each, with hemlock, pellitory, putrid peas, Virginia creeper, white hellebore, and yew-leaves.

Definition.—It has been found difficult *to define a poison.* No single definition is exactly consistent with the common meaning of the term in all its uses. Nature has not discreetly and unconditionally separated all the poisons from all the non-poisons. There

are many substances, it is true, which verify the adage, "Once a poison, always a poison;" but there are other substances which will be poisonous, or not, according to conditions. As a legal definition, that of Dr. Letheby is prudently guarded and generally acceptable: "Anything which, otherwise than by the agency of heat or electricity, is capable of destroying life, either by chemical action on the tissues of the living body, or by physiological action from absorption into the living system." Medical jurists do not limit the quantity which must be capable of destroying life to constitute a poison. In the common idea of a poison, it is a substance which, acting in small quantity, can cause death or sudden illness. But if an article can cause poisonous effects "by physiological action from absorption," or "by chemical action on the tissues," as stated in the definition above quoted, it may be classed as a poison, irrespective of the quantity needful for dangerous results. The alkaloid aconitine is a fatal poison in a dose so small as the twentieth of a grain, while oxalic acid will rarely prove fatal in doses less than half an ounce; but of the two agents the latter is responsible for many more cases of poisoning than the former. There are numerous medicines which have never produced fatal effects, and are never mentioned as poisons, only because they are not liable to be taken in dangerous overdoses. For example, people would not approve a proposition to put poison-labels on packages of quinine; but if quinine were taken in the quantity common for epsom salt, it would cause pretty serious results. Even certain articles generally classed as food prove poisonous in excessive quantities, common salt being an instance.

The degree of *concentration* is an important condition with certain poisons. There are articles which, in the pure and undiluted state, are violent poisons, but when diffused by admixture with inert material are harmless, and in some instances indispensable to life. Oxygen gas, the vital constituent of the air, is poisonous when pure; and ozone, the disinfectant of nature, becomes poisonous by moderate concentration. The most healthful atmosphere contains enough carbonic acid gas, in the volume which a man inhales in twenty-four hours, to destroy life, if it were breathed in the pure state. It is dangerous for man to concentrate what nature has diluted. Various volatile substances giving odors to plants, and flavors to fruits, become mischievous when manufactured in artificial degrees of concentration. Many of the strictly corrosive poisons would be harmless, if enough diluted. The hydrochloric acid of the shops, which is absolute acid dissolved in three to five parts of water, is a deadly corrosive; but, as diluted with over 5,000 parts of watery liquid, the same acid is reported to

be a constituent of the gastric juice for the digestion of food in the stomach. Oil of vitriol, when sufficiently diluted, becomes a mild medicine, which may be taken freely without disturbing the system. These poisons, which owe their virulence to concentration, belong, in the larger part, to the class operating "by chemical action on the tissues."

Chemical combination effects changes of poisons wholly different from the alterations due to dilution and mixture — radical changes, taking place not progressively, but suddenly. None of the properties of a chemical compound, as a rule, can be predicated upon the characters of its constituents. Phosphorus is an active and persistent poison, little modified by dilution; but various compounds of phosphorus belong to our daily food and help build the tissues of the body. The nutrient white of egg and the potent alkaloid strychnine are alike composed of the same four chemical elements. In the transmutations of chemical action, the breadstuffs and sugars become fiery alcohol and acidulous vinegar. On the other hand, the various chemical salts of the same metal, and of the same alkaloid, if alike soluble in the fluids of the body, for the most part closely resemble each other in their effects on the system. Sulphate of copper has the same effect as acetate of copper; sulphate of morphine the same as meconate of morphine.

An antidote to a poison, in the most direct sense, is a substance which will cause such a chemical change of the poison as to render it harmless, and will even accomplish this result in the living body, if administered after the poison. Comparatively few poisons can be met in the living body with efficient *chemical antidotes.* It is true there is scarcely a poison which cannot be transmuted into harmless bodies by the chemist, working in the laboratory; but to do this amid the frail tissues of the body is often like shooting an enemy while he is struggling in the embrace of a friend. But there are antidotes—within the general meaning of this term—which do not change or hinder the poison, but, leaving it to attack the tissues, set up action in the opposite direction, and so brace the system, between the two antagonisms, as to preserve it from fatal oscillation. These may be termed *physiological antidotes.* The extent of their prudent application is even more limited than that of the chemical antidotes. Before describing the antidotes and remedial measures for articles of poison, some attention must be given to the path which a poison takes in the body.

Mode in which Poisons Act.—The principal *avenues by which poisons reach the body* are the following—given in the order of the time required for their introduction:

(1.) By contact with the skin.

(2.) By being taken in the mouth and swallowed.

(3.) By being breathed into the lungs.

(4.) By introduction under the skin and into the blood-vessels.

In poisoning *by the skin*, the injury may lie in the destruction of the skin, as from action of the corrosive acids and alkalies, nitrate of silver, bromine, etc.; or the results may be due mostly to absorption into the circulation through the skin, as in cases of harm from "poison-ivy," and of chronic injury by painter's lead, hair-dyes, and mercurial cosmetics. Preparations of opium, belladonna, aconite, and other active anodynes, are liable to be absorbed in poisonous quantities, when applied in excess to the skin. Woodman and Tidy refer to nine cases of poisoning by external application of belladonna preparations, and three cases by application of tobacco. The rate of absorption through the skin, though slower than through the internal surfaces of the body, may be rapid enough for acute effects of many poisons. Erichsen found the urine turned alkaline sixty-seven minutes after immersion of the feet in solution of potassium acetate. If the skin is blistered or denuded of epidermis, the rate of absorption is greatly increased, and if surfaces are freshly abraded or wounded, they admit poisons directly into the circulation, as in injection under the skin, the most rapid of all modes of administration. For these reasons, especial care should be exercised in treating diseased or injured surfaces with potent remedies.

When *introduced into the stomach*, poisons act, in greater part, by absorption into the blood. Corrosive articles, as caustic acids, alkalies, etc., act here, as on the surface, by destroying the mucous membrane as far as they reach it. Some articles, as corrosive sublimate and oxalic acid, act both locally and by absorption, or, if largely diluted, mostly by absorption. The rate of absorption, when the stomach is empty and the blood-vessels not overloaded, is rapid beyond ordinary conception of the flow of liquids through membranes and along the channels of the body. Müller found that chemicals in solution pass through the bladder of a frog with scarcely appreciable loss of time, appearing on the farther side in less than a second.

The stomach is covered with a fine network of capillary blood-vessels, through which the blood is running from the arteries towards the veins, and, as soon as any liquid passes through the membrane of the stomach, it is hurried on in a multitude of blood-streams into the general circulation over the body. A given portion of blood completes the circuit of the body in about half a

minute, and the entire blood of the body goes through the heart in the average time of about one minute. Before the career of poisons and medicines through the circulation was apprehended, and even unto the second decade of the present century, it was thought that the extreme rapidity with which certain poisons control the system could not be accounted for by absorption and circulation, but must be due to impressions conveyed through the nerves from the inner surface of the stomach to the nerve-centres. Thus, a large dose of prussic acid, which is not a local poison, causes insensibility almost immediately after it is taken into the stomach—usually within a minute, and sometimes in a few seconds. That the rapidity of absorption and blood-circulation is sufficient for these sudden effects is shown by direct evidence. In a case reported by Erichsen, ferrocyanide of potassium appeared in the bladder in from one to two and one-half minutes after it was taken into the empty stomach. During this time, the salt, after going over the system in the blood, had to pass out through membranes and capillaries in the kidneys and flow down the ureters. [See Anatomy of the Kidneys in Vol. II.] Bence Jones found that the lithium carbonate required from five to ten minutes to pass from the (empty) stomach through the system and arrive in the urine.

These evidences show the shortest time in which poisons can reach the brain and spinal cord from the stomach, and the earliest effects produced on the system, but there are wide variations in the time taken for absorption and for appearance of symptoms. Directly after a full meal, the rate of absorption is slow. Experiments indicate that it takes from twenty to thirty minutes for chemicals taken on a full stomach to arrive in the bladder. Also the fulness of the blood-vessels lessens the rate of absorption. But a small part of all the poison in the stomach may have been absorbed when symptoms first appear, and the evacuation of the stomach at this time is by no means always a hopeless measure. Then, after having fully penetrated the system, poisons differ in the time intervening before symptoms appear, as well as in the duration of their symptoms.

Poisons which reach the system *by inhalation into the lungs*, whether permanent gases or vaporized substances, enter the circulation without appreciable delay. In some cases the results are due to interference with respiration, when the consequences are necessarily sudden.

Poisons *introduced into the blood-vessels*, entering the circulation through the veins, begin their action on the system at once. It should be observed, however, in cases of bites and other poisoned wounds, that the poison enters the vessels but gradually,

and ligation of the limbs and applications to the wounds should not be abandoned because a little time has been lost.

1. Poisoning of the Surface of the Body by Growing Plants.

Poison-Ivy.

Poison-Oak and Poison-Ivy, Poison-Sumach, Poison-Dogwood, and Poison-Elder, are common names, differently applied in different parts of the United States to several species of the *Rhus*. Of these the most poisonous is the *Rhus diversiloba*, or poison-oak of California, the *hiédra* of the Spanish. It is found in woods and thickets and on dry hill-sides, generally supporting itself as a shrub with a somewhat vine-like stem, but sometimes climbing over large trees, the stem growing to a diameter of six inches. It has short, leafy branches; the leaves have three or rarely five leaflets, which become discolored; flowers in axillary,* racemose panicles,† and fruit white.

Figure 340.—Swamp-sumach (*Rhus Venenata*).

Rhus venenata, swamp-sumach, poison-dogwood, or poison-elder found in both the Northern and Southern States, grows in swamps as a low, smooth, branching shrub, from six to eighteen feet high. Its leaves are compound, dotless, alternate, odd pinnate and stipulate, with from seven to thirteen obovate-oblong, entire leaflets.

Rhus Toxicodendron, poison-ivy, three-leaf-ivy, poison-vine, poison-oak. A climbing stem, with three leaflets, rhombic-ovate. Found from Canada to Georgia.

---

* Where the leaf joins the stem.

† The stalks of the flowers arising in masses from an erect spike.

These plants poison some persons without contact, though with more severe results from contact with the skin, while other persons are scarcely affected by them.

The Symptoms are those of erysipelatous inflammation of the skin, itching, burning, redness, swelling, formation of vesicles, tumors, severe suffering, and serious disturbance of the system. Steele* says it has been estimated that, in California, the number of persons at any time suffering from the scourge of the poison-oak of that State is not less than three thousand.

The poisonous principle of Rhus toxicodendron has been separated, as toxicodendric acid, volatile, and having resemblances in character both to formic and acetic acids.† In *Rhus venenata*, Cotton‡ reported finding a crystallizable, non-volatile acid. Buckheim in 1873, reported finding in *R. toxicodendron*, a vesicant, non-volatile substance, named cardol. A non-volatile body, however, can hardly be the chief agent of rhus poisoning.

FIGURE 341.—Poison-Ivy (*Rhus toxicodendron*).

Treatment.—The best treatment of rhus-poisoning—at least of the effects of *R. toxicodendron* and *R. venenata*, the varieties chiefly prevailing east of the Rocky Mountains—undoubtedly consists in the free and frequent application of alkalies to the exposed parts, the earlier the better. Ammonia water, dilute enough not to irritate, solution of bicarbonate of sodium, weak solution of potassa, lime-water, even soap (in absence of other forms of alkali), may be employed. For the effects of the poison-oak of California, Dr. Canfield (1860) and others have introduced the use of a balsamic plant, indigenous to that State—the *Grindelia robusta*,§ the fresh-bruised herb, or extract, being rubbed over the part affected. [See also Vol. II., Chapter on Diseases of the Skin.]

* Pro. Am. Phar. Asso., 1875, p. 638.

† Maisch, Pro. Am. Phar. Asso., 1865, p. 173.

‡ Am. Journ. Phar., 1874, p. 355.

§ Pro. Am. Phar. Asso., 1875, p. 637.

Nettle.

Nettle is the common name for the species of Urtica, in the order Urticaceæ, many of which are covered with stinging hairs, carrying an acrid juice. This juice contains formic acid, an irritating volatile acid, found also in some caterpillars and in the red-ant, and the first member of the chemical series to which acetic acid belongs. Nettles lose all irritating properties by boiling, and several species are used as pot-herbs.

Treatment.—The stings of nettles can be quickly cured by washing with ammonia suitably dilute, or by a mixture of one part of carbolic acid, with five parts each of glycerine and ammonia water, and fifty parts of water. In absence of these, sodium carbonate in dilute solution may be used.

2. Poisoning by the Stings and Bites of Animals.

Stings of Insects.

Little is known of the constituents of the irritating secretions injected by mosquitoes, bees, wasps, horse-flies, spiders, and other stinging insects, further than that they are mostly acid in character.

Treatment.—In the punctures made by certain bees and hornets, the sting remains in the wound, where it can be seen as a black point, and should be seized with fine forceps and extracted. The part should then be washed repeatedly with ammonia moderately diluted. The alkaline solution of carbolic acid, mentioned in the foregoing paragraph, will be found an efficient remedy.

Bites of Serpents.

In the Northern United States the only poisonous serpents are the various species of the rattlesnake, and, in some sections, the copperhead. Including the Southern and Western States, there are about twenty-two species of venomous serpents in the country. It is now held that the poison of all venomous serpents is alike;* the difference in their effects being due to degrees of concentration, the quantity of the poison, and to the nature of the wound. Serpent poison is an albuminoid body, and presents some analogies to the albuminoid ferments, such as pepsin † and ptyalin.‡ It may be

* Weir Mitchell. † From the gastric juice ‡ From the saliva.

swallowed with impunity, not being capable of absorption through membranes. It is not affected by alcohol, iodine, carbolic acid, strong alkalies, or dilute acids, and when dried it retains its potency for years. Half a drop of rattlesnake venom will kill a pigeon, when introduced into the blood. Nevertheless the living body has the power of gradually neutralizing it, or of eliminating it, within certain limits. Rattlesnake bite is not often fatal.

Treatment.—Dr. Weir Mitchell, for fifteen or twenty years an investigator of this subject, advises the following plan of treatment: The limb should be tied tightly around close above the wound at once, the wound cut open freely in the line of the fang-mark, and the flow of blood favored by squeezing, and by washing with warm water, if this can be obtained. Hunters suck the wound. If obtainable, an elastic band should be made to take the place of the ligature. Then alcohol, in some form, should be given, till the heart is excited, when the ligature may be loosened a little to admit some of the poison to the general circulation. When the heart again fails, the ligature is tightened and more alcohol administered. "So the poison may be fought in detail." "The alcohol is not an antidote." Dr. Mitchell disfavors the administration of alcohol to extreme intoxication, using it only as a stimulant. It is testified by abundant evidence that large quantities of whisky are borne under influence of the poison. Recovery may be early and complete, or a dangerous stage of depression may supervene, with breaking down of the blood, which is unable to coagulate, and infiltrates the tissues from the wound and exudes from mucous surfaces. [See, also, page 622.]

3. Poisoning Incident to Occupation.

Phosphorus Poisoning in Manufacture of Matches.

"The Lucifer Disease" is liable to attack those engaged in the dipping, drying, or packing of matches.

The **symptoms** are weakness, fatigue, pains in the bowels, diarrhœa, intermittent toothache, decayed teeth, receding gums, and exposure and disease of the bone of the jaw, the lower jaw being most often affected. The poisoning is due to vapor of the oxides of phosphorus (possibly in part to ozone), taken first by inhalation and, after the teeth become decayed, from access of the acid oxides of phosphorus through the saliva to the lower jaw. There is large increase of phosphates in the urine.

Red phosphorus is not poisonous. Those engaged in work with

yellow phosphorus should guard against injury by taking the following:

Precautions.—A very dilute solution of bicarbonate of sodium should be kept at hand. The hands and face should be washed with this frequently, and always on leaving the factory. The mouth should be frequently rinsed with the same. A little of the soda solution, very dilute, or a spoonful of lime-water, should be swallowed, occasionally, at times when digestion is not going on. It is recommended to have open dishes of oil of turpentine exposed in the work-rooms. The rooms should of course be well ventilated, and the "dipping" should be done in a room not open to the others.

Lead Poisoning by Working with Lead Paint or Lead Metal.

Of 1,213 cases of chronic lead-poisoning, collected by M. des Planches, 406 occurred with white-lead manufacturers, 305 among house painters, 68 among color-grinders, 63 among red-lead manufacturers, 54 from work in common earthen pottery, 52 with type-founders, 47 with carriage-painters, 35 among lapidaries, 33 among ornamental painters, and the remainder among a large number of trades.

The **Symptoms** are obstinate constipation, indigestion, feeling of depression, loss of appetite, metallic taste, fetor of breath, respiration often rapid, with rarely any fever or acceleration of pulse, abdominal colic (relieved by pressure), "lead palsy" of the extensor muscles causing "the dropped hand," and (generally early) a "blue line" around the gums (deposition of lead sulphide). The fæces are usually dark, from presence of lead sulphide.

Precautions.—Workmen should observe great cleanliness of the entire person, of the hair, and especially of the hands and face, with use of soap in bathing. Clothing of compact linen or cotton material, frequently washed, is the best, the head being protected by a cap. Sulphurous baths are recommended. Meals should not be eaten in the work-rooms, nor without carefully cleansing the hands and nails and the teeth. The work-rooms should be well ventilated, and grinding should be done under water or other liquid. The bowels should be kept open, and, if a purgative is required, sulphate of magnesium (Epsom salt) is to be preferred, as it changes any lead in the system to insoluble sulphate. Any disturbance of digestion or failure of appetite may be met by the administration of four to six drops of the aromatic sulphuric acid, in a third of a tumblerful of water, before each meal. If the disease

has set in, the treatment should be directed by a physician, and the occupation in most cases must be abandoned.

4. Poisoning from Use of Cosmetics.

Face Powders, Enamels, and Lotions.

The only poisonous constituents likely to occur in these, are lead compounds ; but in rare cases the lotions contain corrosive sublimate (mercuric chloride). In 1870 Professor Chandler, in the Health Board of New York City, reported upon seven "white powders for the skin," all free from injurious metals, and containing only French chalk, clay, and magnesia. Of seven enameling liquids, three were heavily laden with white lead (in suspension), three were free from lead and made with zinc white, and one was made up with chalk. Of six "lotions for the complexion," one was heavily charged with corrosive sublimate, and the rest were free from injurious metals. In 1876 E. J. Risser, from work under the writer's direction, reported upon twelve cosmetics, including six white powders, two carmine-colored powders, three white enamelling lotions, and one carmine-colored lotion, none of which contained injurious metals—three containing bismuth carbonate, two having zinc oxide, and eight carrying nothing heavier than chalk or white earth.* In 1874 the apothecaries of Copenhagen, Denmark, agreed to substitute, for the "generally poisonous" face powders in use, the following harmless mixtures : *White*—oxide of zinc, 30 parts ; wheat starch, 250 parts ; oil of rose, 3 drops. *Red*—carmine, one part ; carbonate of magnesium, 4 parts. The writer would suggest that these articles—put up to order at any drug-store—may be used with greater safety than the preparations of unknown and irresponsible manufacturers. The continued application of white lead to the skin, either in powder or cream, is likely to produce some degree of chronic poisoning. (See lead-poisoning by working in lead paint, etc., on preceding page.)

Hair Dyes and Restoratives.

A large number of the dyes and lotions for the hair contain lead acetate (sugar of lead) as their essential constituent ; a smaller number of the dyes—those acting instantaneously in one solution —consist of silver solutions. Of sixteen dyes and restoratives analyzed by Prof. Chandler for the Health Board of New York, one

* Pro. Am. Phar. Asso., 1876, p. 419.

consisted of ammoniacal silver nitrate, and all the rest contained lead, in quantities from one to sixteen grains (metal) to the fluid ounce.* A golden yellow hair-coloring has been done by hair-dressers with arsenical solution and ammonium sulphide; and brown coloring, by chloride of gold. It is decidedly unsafe to apply lead solutions to the scalp. Numerous cases of lead palsy have resulted from the practice, and disturbance of health must often result from this cause when the real difficulty is not recognized. (See Symptoms, under Lead Poisoning, on page 780.) Silver solution (lunar caustic) is corrosive to the hair and to the epidermis so far as stained by it, but it is far less likely to cause constitutional effects than lead. Hager (1873) proposed "an unhurtful hair-dye" as follows: 10 parts of subnitrate of bismuth, with 150 parts of glycerine, are heated together in a glass vessel, on the water-bath; solution of potassa is then added gradually, with agitation, until a clear solution is obtained; then concentrated solution of citric acid is added, until the reaction remains but slightly alkaline, when orange-flower water is added to make the liquid measure 300 parts, and the solution is to be lightly colored with aniline.

5. Poisoning by Colored Fabrics.

Papers and Cloths Colored Green and of Colors Toned with Green.

Arsenical green is used mostly for the green of the best wall-papers, for tarlatans, and for much of the green of carpets; also as a constituent of drab and a tone of other colors for wall and window papers. The compound itself is Schweinfurt green—the aceto-arsenite of copper, or, less frequently, Scheele's green—the arsenite of copper, both of which compounds are sold as Paris-green. The poisoning is due to the arsenic, scarcely at all to the copper.

The *mode of poisoning* by arsenical wall-papers, carpets, and drapery, is chiefly by the dust constantly wearing off from the walls and fabrics, and permeating the air which is taken into the lungs. Chemists, both in this country and in Europe, have obtained arsenic by analysis of the dust settling in rooms hung with green paper. It has been surmised that, in very moist air, the deadly arsenious hydride or gas may be formed; but if the gas is formed at all, it is probably far less influential than the dust. A good many cases of distinct poisoning have been traced to arseni-

* Am. Jour. Phar., 1870, p. 362.

cal wall-paper Six cases are reported in the *Michigan Board of Health Report* for 1874. How far the healths of individuals and families have been injured by residence within "the walls of death," as Professor Kedzie terms them, no man can declare.

The *quantity of arsenic* held in the colored sizing of wall-papers and woven goods is by no means small. Woodman and Tidy found in one sample of paper as much as thirty-five grains of arsenious acid to the square foot.

Again, in determination of the arsenic, in six samples of green tarlatan, Mr. Kerley obtained, under the writer's observation, from 115 to 149 grains of aceto-arsenite of copper per yard; and in twelve wall-papers from 0.8 to 56.9 grains of the aceto-arsenite per square yard.* Dr. Kedzie, of the Michigan Board of Health, reports from one to five grains of arsenic per square foot, in five cases, where poisoning had resulted.

The use of arsenical-green-colored fabrics extends to a multitude of articles of everyday use, and is everywhere beset with incidental danger, if not destined to direct mischief. Lamp-shades of poison-green are believed to be especially hurtful, because the heat to which they are subjected favors vaporization of the arsenic. Green table mats, green wafers, green toys of various sorts for children, green glazed paper bands and covers for children's confectionery, green air-balls, and green artificial flowers, have been proven guilty in distinct cases of poisoning. The green tarlatan dresses have poisoned ballet-dancers who wear them and seamstresses who make them. Women using green sewing-silk find, even by the metallic taste, that it is unsafe to bite the thread. In the manufacture of arsenical paper, it is stated† that a paper-printer cannot endure to work more than two or three weeks at a time with arsenical colors.

Papers and cloths may be *tested for arsenic* by Marsh's method, modified as follows: Place some of the fabric in a flask or large test-tube; fill two-thirds full with water made slightly alkaline with potassa or soda; put in a piece of sodium-amalgam (Davy); cover with a piece of filter-paper wet with silver nitrate solution, and set aside. If arsenic is present, the paper will soon be blackened. Also, arsenical greens are decolored by ammonia. Again, if the ammonia solution be poured off clear, upon a glass plate, and a minute fragment of nitrate of silver (crystal or stick) be placed therein, a yellow precipitate around the fragment indicates the presence of arsenic.

---

* New Remedies, VI. (1877), p. 246. † Draper: Mass. Board of Health Report.

Fabrics Colored with Aniline Dyes.

Aniline compounds of themselves have been the subject of discussion as to whether poisonous or not, and while it is pretty certain that some of the pure aniline compounds are poisonous if taken into the stomach, it is not asserted that they poison the skin or the atmosphere. The more poisonous agent in the aniline dyes in use is *the arsenic they contain.* This is required in their manufacture and not wholly removed. The poisoning has occurred chiefly from use of *magenta-colored socks and under-garments for children* and in some cases with adults. The aniline dyes of *carpets* have also been found to contain arsenic in quantities injuriously large. And *wall-papers,* again, are printed in reds with the use of arsenical aniline dyes.

American Leather Cloth

is said to be heavily loaded with *lead.* The health officers of Berlin lately declared against its use in children's carriages, reporting over forty per cent. of lead in it. Its use in hat-linings is a most reprehensible practice

6. Poisonous Plants Liable to be Eaten.

Aconite.

Aconite.—Monkshood, Wolfsbane, Blue-rocket, *Aconitum Napellus, A. uncinatum,* and other species of Aconitum. The entire plant is poisonous: the root has been mistaken for that of horse-radish, with fatal results.

Aconite root is short and tapering, like a carrot; brown externally, but when cut it is at first white, becoming red on exposure. Tasted, it causes tingling and numbness of the tongue and lips. At full growth an older root is usually joined to a younger one of lighter color.	Horse-radish root is long, and not much tapering; light brown externally, and when cut is white, both at first and after standing. It is bitter and hot to the taste—does not cause numbing of the tongue and lips.

The stem is erect, and from two to six feet high; the plant perennial; the leaves, dark green on the upper surface, cause numbness of the mouth when chewed. The flowers are violet to blue. *A. reclinatum,* Trailing-wolfsbane, found in Virginia, and southward in the Alleghanies (Gray), has a trailing stem; flowers white.

Aconite contains a small proportion of an alkaloid, aconitine, one-fiftieth of a grain of which is poisonous. Any quantity of root or

leaves over a few grains may cause illness ; sixty grains of the root have proved fatal. Woodman and Tidy refer to nine cases of poisoning by eating the fresh root, three cases from eating the fresh leaves in salad, and twelve cases in one company from taking the juice of the leaves in mistake for scurvy grass.

FIGURE 342.—Aconite flowers, leaves, and root.

Symptoms. — In from a few minutes to one hour, numbness, tingling, and dryness of the mouth and throat ; then giddiness, with numbness and tingling of limbs; loss of power in legs ; sometimes pain in abdomen, frothing from the mouth, followed by vomiting, purging, and faintness. Sometimes the person, though paralyzed, retains consciousness ; in others there are dimness of sight and delirium. There is not the stupor or comatose state present with narcotic poisons. The pupils are dilated, the skin is cold and livid, and the action of the heart is rendered very feeble. Convulsions are not common.

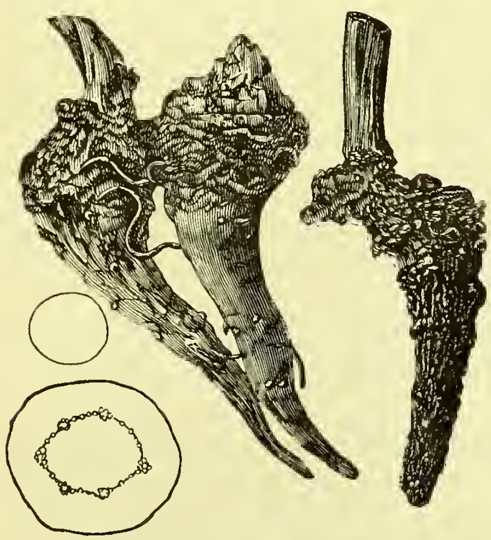


FIGURE 343.—Typical roots of Aconite.

Treatment.—The stomach should be evacuated, by use of an irritant emetic, as ground mustard in teaspoonful doses. Then stimulants should be promptly administered, and stimulating applications and frictions used externally. Physicians sometimes administer strychnine, carefully, as a physiological antidote.

Castor-Oil Plants: the Seeds. *Ricinus Communis.*

A single seed of this plant usually produces ill symptoms, and from three to twenty seeds have produced fatal results. The poisonous principle—certainly not in the oil—has not been determined.

FIGURE 344.—Leaves, flowers, and seeds of the Castor-Oil Plant.

Three of the seeds have sufficed to cause the death of a man.

Symptoms.—According to H. C. Wood, the symptoms do not usually come on until from two to five hours after the beans have been swallowed. First there is severe pain in the belly, then violent vomiting and purging, with perhaps bloody stools. After the purging has continued for a little time, the patient becomes cold; a cold perspiration covers the surface; the features are pinched; there is thirst, restlessness, and a small, feeble pulse.

Treatment.—See page 818.

Crazy Weed.

Crazy Weed of Colorado. Oxytropus Lamberti. Yarrow, Milfoil.—A low, nearly stemless perennial herb, growing abundantly in pasture lands in Colorado. It bears twenty to forty small yellowish-white flowers on a single flower-stalk. The flowers are tipped with purple. It is a belief among the people that cattle and horses acquire a taste for this plant, and that, in consequence of eating it, their appetite for other food fails; they become emaci-

ated, partly demented, and symptoms of founder and paralysis supervene. It is also said to have been used for a beer, and to affect man much in the same manner.*

Buttercup.

Crowfoot. Buttercup. *Ranunculus bulbosus, R. acris, R. repens, R. sceleratus*, and other species of Ranunculus, common in pastures and meadows. The whole plant is pervaded by a volatile principle, acrid, irritating, and excoriating, capable of blistering the skin, but wholly dissipated in drying. Grazing animals avoid the plants when fresh, but eat them in hay without harm.

Symptoms.—When taken into the mouth, buttercup causes a singular, intense cutting sensation in the tip of the tongue, which pretty certainly prevents its being swallowed, and soon ceases after the plant is spat out. Sometimes it causes intense irritation and inflammation of the mouth.

Treatment.—In slight cases nothing is required; in more aggravated, cooling and astringent mouth-washes. If the plant has been swallowed, an emetic of ipecac or mustard and water.

Darnel.

Darnel Seeds. Bearded Darnel. *Lolium temulentum.*—The only one of the grasses, as Lindley states, proven to have deleterious properties. The seeds are likely to occur mixed with grains of wheat or rye, and bread made therefrom has been said to cause giddiness, intoxication, vomiting and purging, dilation of pupils and confusion of vision, tremors and great prostration. The sufferers have nearly all recovered. It has been stated that the effects are alike upon man, horses, and sheep, while cows, pigs, and chickens are not affected by it. A bitter extractive of the seeds poisoned a pigeon. At one time the poisonous results previously ascribed to darnel were attributed to presence of ergot; but later observations, especially those summarized by Wittstein in 1875, show that darnel contains peculiar poisonous bodies. Like rye and wheat, however,

* Miss Catharine M. Watson, in 1876, made a thorough chemical analysis of this plant. It contains much resinous substance; and a substance easily fusible, amorphous so far as could be ascertained, nitrogenous, and giving the reactions of an alkaloid with all the general reagents. Physiological experiments were made without very determinative results; those and further chemical examination being interrupted while awaiting another supply of material. (From an Unpublished Report at Michigan University. As to the effects of the plant on animals, see Dr. A. Kellogg, *Cal. Acad. Sciences*, vi., 3; Dr. Rothrock, *Philadelphia Acad. Nat. Sciences*, 1877, 274, July 31.)

it is liable to be the subject of the ergot-fungus. And, as experiments made with perfectly healthy seeds have produced no poisonous effects, it is probable that the symptoms attributed to it are the result of a diseased condition of the seeds. The starch granules of darnel in flour are easily distinguished under the microscope from those of wheat, being only one-third as large, and perfectly circular, with moderately wide margin, and bright unmarked surface. The seeds have a sweetish taste, and are without odor.

Treatment.—A purgative, like castor-oil, to empty the bowels, and alcoholic stimulants, ammonia, and heat, to relieve the weakness and prostration.

Ergot.

Ergot. Spurred Rye. Mutterkorn. *Secale Cornutum.*—A parasitic fungus growing upon rye (and less frequently upon wheat, barley, and oats), and taking its nutriment at the expense of the grain in which it grows. The spurs are from one-quarter to one inch long, one-sixth to one-third inch thick, purple or violet-brown externally, and yellowish-white or violet-white internally, of an acid after-taste, and slight disagreeable odor. Treated in powder, with solution of potassa, the characteristic odor (due to trimethylamine) is strongly developed, and may be obtained from flour containing at the least one and one-quarter per cent. of ergot. A closer *test for ergot in flour*, revealing at the least one-quarter per cent., may be made as follows :* 10 parts of the flour are boiled in a dish with 30 parts (by weight) of 90 per cent. alcohol, and the liquid pressed out with a fine muslin strainer. The residue is stirred with 10 parts more of alcohol in a narrow dish and left to settle. If the liquid is colored, the material must be washed with alcohol again, and pressed and treated again with 10 parts of alcohol. Add now of dilute sulphuric acid (1 part of the concentrated acid to 5 parts of water) from 10 to 20 drops,


FIGURE 345.—A head of Spurred Rye.

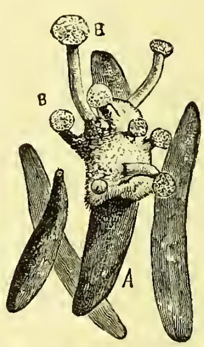


FIGURE 346.—Grains of Ergot.

* Jacoby: Dragendorff's *Ermittelung von Giften*, p. 323.

stir, and leave to settle. In absence of ergot, the liquid will appear colorless or, at most, pale yellow; if ergot is present, the liquid will be red, of greater or less intensity. The test depends on a color-substance of ergot, dissolving red in acidulated alcohol, but not dissolving in the alcohol alone, which removes the coloring matter of the flour. Large doses of ergot are required for acute poisoning; but *chronic poisoning*, as a fatal epidemic, is believed to have resulted from use of breadstuffs containing ergot.

Symptoms.—Giddiness and cramps, with dilation of pupils, are the chief of the acute symptoms; creeping sensations and shrivelling of the limbs at the joints have occurred among the chronic effects. Ergot is much used as a medicine.

Treatment.—See page 818.

Fools' Parsley.

Fools' Parsley. Aethusa cynapium.—Annual herb, found about cultivated grounds in New England. Has much the aspect of poison-hemlock, but with unspotted stem. Fetid odor, and poisonous effects. As the common name indicates, it has been mistaken for parsley (which its nauseous odor should prevent).

FIGURE 347.—Fools' Parsley.

Symptoms.—The leaves produce nausea, vomiting, headache, giddiness, drowsiness, spasmodic pain, and numbness. The pains caused by it are said to be intense, and in children it has produced convulsions. In cases less severe it has caused redness of the face and eyes.

Treatment. — There is no specific treatment. An emetic to empty the stomach and heat to the extremities, with cold cloths on the forehead, will relieve some of the symptoms. Stimulants will be proper if there is faintness or much prostration.

Foxglove.

Foxglove. Digitalis Purpurea. — A cultivated ornamental plant. Its poisonous constituent is digitalin, sometimes used medicinally in doses not over $\frac{1}{50}$ grain. It is cumulative in its action on the system. In poisonous doses it retards the action of the

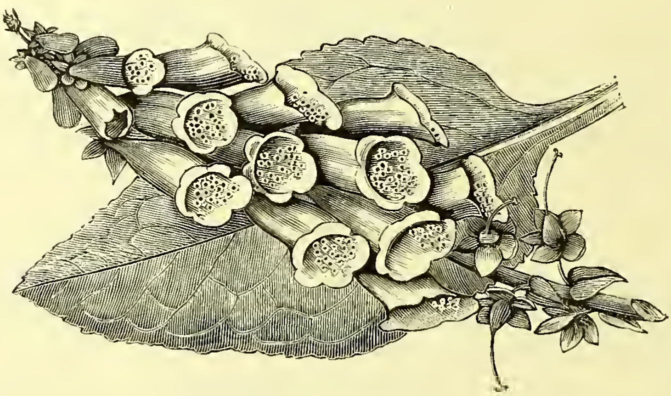


FIGURE 348.—Foxglove.

heart, the poisonous symptoms being a faint, slow, and irregular pulse, pupils dilated; sometimes vomiting, pain, and purging. In fatal cases death seldom occurs before the sixth day. The patient must keep in the recumbent posture. All parts of the plant are poisonous, if taken in doses over three or four grains, the seeds being most potent.

Treatment.—See page 818.

Hellebore.

Hellebore. American Hellebore. *Veratrum Viride.* Green or Swamp Hellebore. Indian Poke. Found from Canada to Carolina, growing on wet ground, three to six feet high, with bright green leaves, flowering from May to July, in panicles, greenish-yellow. Taste, bitter and nauseous. All parts of the plant are poisonous, in doses over a few grains. *White hellebore,* used as an insecticide, does not grow in this country. (See under Poisoning from Use of Vermin-killers.) *Helleborus viridis,* growing on Long Island, is a poisonous plant.

Symptoms.—A pulse that is almost imperceptible and slow, intense muscular prostration, a cold, clammy skin, faintness, dizziness, efforts at vomiting, and loss of sight. Sometimes partial unconsciousness.

Treatment.—Empty the stomach by an emetic, and administer strong tea and stimulants. The person must be kept absolutely

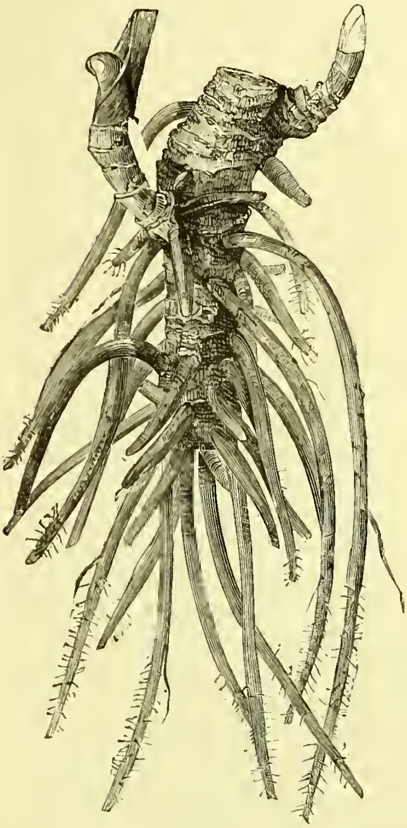


FIGURE 349.—Root of American Hellebore.

FIGURE 350.—Black Hellebore.

quiet, and hot bottles or poultices may be applied to the extremities and over the heart.

Hemlock.

Hemlock. Conium maculatum. Poison-Hemlock. Spotted Hemlock.—Naturalized from Europe, growing along roadsides and in waste places. The leaves have been *mistaken for parsley.* A branching herb, three to six feet high, having a biennial spindle-shaped whitish root (something like that of *parsnip*), a hollow stem marked with brownish purple spots, the lower leaves more than a foot long and tripinnate, the upper leaves smaller and bipinnate.

In June and July it bears small white flowers, when it exhales a fetid, mousy odor. The leaves, when bruised, exhale the same odor. The seeds are the most active part of the plant, all parts being poisonous if taken. Three or four grains of the leaves constitute a medicinal dose. The poison-hemlock of the ancient Athenians has been held to have been this plant, but may have been Cicuta, the "water-hemlock." Conium maculatum owes its power to a volatile alkaloid, named conia.


FIGURE 351.—Poison Hemlock.

The symptoms are headache, dim vision and dilation of pupils, drowsiness, intermitting pulse, paralysis, coma. The loss of muscular power is one of the early symptoms, and in cases where death has occurred it appears to have followed paralysis of the muscles of respiration.

Treatment.—Empty the stomach as soon as possible, and give strong tea, tannic acid, or decoction of oak-bark, and repeat the emetic. Use dry heat externally, and give stimulants. If the movements of respiration become feeble, artificial respiration must be resorted to.

Water-Hemlock.

Water-Hemlock. Cicuta maculata. American Water-Hemlock. Spotted Cowbane. Musquash root. Beaver-poison. — The roots mistaken for parsnips. The plant grows commonly in swamps and wet meadows; three to six feet high; stem stout and streaked with purple. The smell and taste of the root are said to resemble those of parsnip. It is very poisonous.

The symptoms commence with giddiness and dryness of the throat, flushed face and dilated pupils, with dimness of sight. There is pain in the stomach and vomiting.

Treatment.—Similar to the foregoing.

Henbane.

Henbane. Hyoscyamus niger. Black Henbane.—In Northern United States, growing in waste places where the soil is very rich. Abundant about Detroit, Mich. The root has been mistaken for chicory and for parsnips; children have been poisoned with the berries; and the young shoots have been mistaken for parsley and eaten as a salad. All parts of the plant are poisonous, containing a potent alkaloid named hyoscyamine.* It is biennial, growing from one to four feet high in the second year. The leaves are sea-green, oblong, viscid, hairy, and surround the stem; the flowers yellowish, with purple veins, hanging from the ends of branches.

FIGURE 352.—Black Henbane.

The **symptoms** come on suddenly within a half-hour after the poison is taken, with giddiness, marked delirium, and dilation of the pupils, and resemble those of nightshade-poisoning, which see on page 798.

Treatment.—See **Nightshade**, page 799.

Indian Turnip.

Indian Turnip. Arum triphyllum. Dragon Root. Jack-in-the-pulpit, Wake Robin.—Common in all parts of the United States, in moist and shady places. The root is tuberose, the leaves arrow-shaped; a large, erect flower-stalk, bearing a variously colored hood, within which is a club-shaped flower-cluster, green, purple, black, or variegated. The flower-cluster and hood give way to a cluster of scarlet berries. All parts of the plant are very acrid to

* See list of alkaloids in Nightshade Family, on page 799.

the taste, and act as irritant poison, with severe and, many times, fatal results. The poisonous components are very volatile, and are dissipated by drying. From the acrid European species (*A. maculatum*) Portland arrow-root is manufactured, the root of both species abounding in starch of fine quality.

Symptoms.—After chewing a portion of the plant an intense pricking, stinging pain is felt through the mouth, as if caused by a multitude of needles, accompanied with a profuse flow of saliva, and sometimes followed by considerable soreness.

Treatment.—When the root or plant is fresh, it is so intensely acrid as to render it hardly liable to be swallowed. Milk will greatly relieve the smarting of the mouth and tongue caused by it.

FIGURE 353.—Indian Turnip.

FIGURE 354.—Yellow Jessamine.

Jasmine.

Jasmine. Gelsemium sempervirens. Yellow Jessamine.—Grows in rich, moist soils, from Virginia southward. A well-known,

beautiful climbing plant, bearing clusters of deep yellow, fragrant flowers. The flowers and root are both capable of acting as a poison, causing relaxation of the muscular system, giddiness, dimness of vision, great prostration. In small doses gelsemium preparations are much used medicinally. The plant contains a potent alkaloid—gelseminine, and a characteristic acid—gelseminic acid.

Treatment.—The effects of gelsemium may be counteracted, to some extent, by stimulants.

Lobelia.

Lobelia. Lobelia inflata. Indian Tobacco.—A well-known low herb, growing through Canada and the United States. It has a nauseous and fiery taste when chewed. It contains a very potent volatile alkaloid—lobelina, and acts as a violent emetic, even in comparatively small doses. Taken in excess, it has produced fatal results.

FIGURE 355.—Indian Tobacco.

Symptoms.—Nausea and violent vomiting, accompanied with intense prostration, cold, clammy surface, and great muscular weakness. In some fatal cases vomiting has not occurred, and in others convulsions have taken place as death has approached.

Treatment.—Wash out the stomach with warm drinks, such as strong tea, solutions of tannic acid, decoction of oak-bark. Use alcoholic stimulants and ammonia internally, and apply dry heat to the surface of the body.

Mandrake.

Mandrake. May Apple. *Podophyllum peltatum.*—An herb common in moist, shady woods and marshy grounds. It grows about a foot high, bearing a large, solitary white flower, rising between two leaves of the size of the hand. The fruit ripens in the latter part of September, is yellowish and pulpy, slightly acid,

harmless, and sometimes eaten. The leaves have the properties of the root in a less degree.

FIGURE 356.—Mandrake.

Both the leaves and the root produce violent purging, the movements, in some cases, containing blood.

Treatment.—Cases of accidental poisoning from the fresh root are not common, but in a dried state it is sometimes taken as a domestic remedy in over-doses. Salt in any form should be avoided, as it is said to increase the griping, while fresh milk, or better, buttermilk, lessens its griping effects.

An emetic should, of course, be given if the dose is recently taken; and later, doses of fifteen to twenty drops of tincture of hyoscyamus, or of tincture of opium, at intervals of half an hour, till three or four doses have been taken, or a physician arrives, to relieve the pain and diarrhœa. Hot poultices to the belly will also be of service.

Mushroom.

The common, edible mushroom is *Agaricus campestris*, but other varieties are eaten and prized, to a limited extent. Numerous species are poisonous. The edible species are said to become deleterious, and even poisonous, when grown in wet, shady places; and to some persons almost every mushroom is poisonous. Bad effects are more likely to result from eating them raw than when cooked. According to Letellier, there are two active components in the poisonous fungi—an acrid, volatile substance, and an alkaloid. The edible mushroom contains about 91 per cent. water; 3.4 per cent. cellulose, mannite, dextrine; 4.7 per cent. nitrogenous compounds, and less than ½ per cent. each of fat and salts. Nothing but a practical study of species can enable one to distinguish all the edible mushrooms; but the following comparative description, by Bentley, shows the distinguishing characteristics of the *Agaricus campestris* and some other safe varieties:

EDIBLE.	POISONOUS.
1. Grow solitary in dry, airy places.	1. Grow in clusters, in woods, and dark, damp places.
2. Generally white or brownish.	2. Usually of a bright color.
3. Have a compact, brittle flesh.	3. Have a tough, soft, watery flesh.
4. Do not change color when cut and exposed to the air.	4. Acquire a brown, blue, or green tint when cut and exposed to the air.
5. Juice watery.	5. Juice often milky.
6. Odor agreeable.	6. Odor strong and disagreeable.
7. Taste neither bitter, astringent, acrid, nor salt.	7. Taste either bitter, astringent, acrid, or salt.

Ketchup (or Catsup) was at first a prepartion of mushrooms, though latterly it is more often made with tomato. One manufacturer of ketchup in London, England, obtains annually many tons of mushrooms from all parts of the United Kingdom, mostly *A. campestris* and *A. arvensis*, at prices varying from one to sixpence sterling per pound.

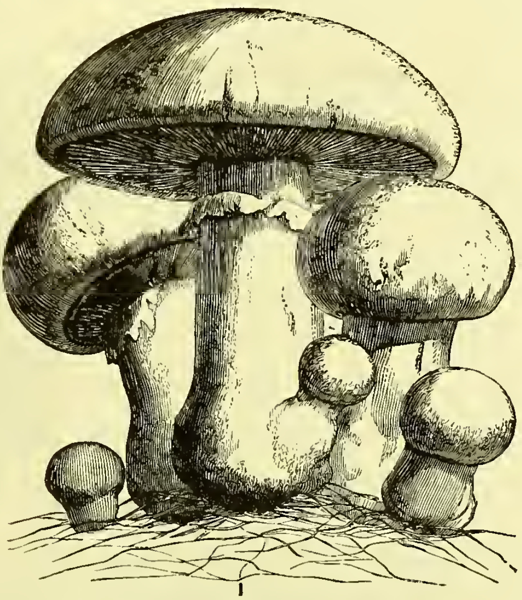


FIGURE 357.—Edible Mushroom.

It is well to bear in mind that, owing to the watery nature of mushrooms, they undergo putrefaction with great ease, and that it is very probable that in this state poisonous principles may be developed in mushrooms which are quite wholesome while in a fresh state.

The symptoms of poisoning by mushrooms come on at very different periods after eating them, and consist, in some cases, of narcotism. giddiness, dimness of sight, delirium, coma, and, in other cases of irritation, pain, purging, vomiting.

Treatment.—As mushrooms may remain for a long time undigested in the intestines, it is advisable to give a purgative as early as possible, and one like castor-oil is better than a saline like Epsom salts, as it helps to envelop the poisonous masses. An emetic like ipecac will also be required. If the person becomes faint and cold, use stimulants, hot bottles, and rest. Tincture of Belladonna (in

five to ten drop doses every thirty minutes until the pupils become dilated, or four doses are taken, or the doctor comes) is the natural antidote.

Nightshade.

Atropa Belladonna. Deadly Nightshade. — An herbaceous plant, native to Europe, cultivated in this country, and in places taking root spontaneously. The name, belladonna, was given in the sixteenth century, from the use of a distilled water of the plant as a cosmetic by the Italian ladies. It had been designated at an earlier period, as *solatrum furiale*, and *solatrum mortale;* and it is believed to have been the plant referred to by Shakespeare, in the witches' scene, as "the insane root that takes the reason

FIGURE 358.—Deadly Nightshade.

prisoner." The Nightshade Family, *the solanaceæ*, embrace quite a number of poisons classed as "deliriants," several of which have borne the name of nightshade. The plants choose a soil rich with fully decayed material, deadly nightshade growing about ruins in Southern Europe, and henbane, nightshade, and tobacco, all burning to an ash very rich in nitrate of potassium. Those of the family which are poisonous owe their power to minute portions of exceedingly potent alkaloids—nitrogenous bases more or less easily volatile and having common characteristics—so that certain of them can hardly be distinguished from others, while the same alkaloids are found in more than one species, as seen in the following list:

SOLANACEOUS PLANTS.		CHIEF ALKALOIDS.
Black Nightshade	contains	Solanine (differing from atropine).
Henbane	"	Hyoscyamine (allied to atropine).
Deadly Nightshade (Belladonna)	"	Atropine
Potato (seed, at times)	"	Solanine.
Stramonium	"	Daturine (identical with atropine).
Tobacco	"	Nicotine (volatile).
Tomato (green, at times)	"	Solanine.
Woody Nightshade	"	Solanine.

Deadly Nightshade has an erect stem reaching three feet in height, with alternate, soft, smooth leaves; flowers (in June and July) dull reddish, bell-shaped, large, and pendent; berries (in August and September) first green, then purple, and lastly black. The bruised leaves give a fetid odor; the berries taste sweet, but mawkish; the root, which is long and creeping, has a bitter taste. All parts are poisonous, the root being strongest. Atropine, the alkaloid, cannot be safely taken in doses above the fiftieth of a grain.

The symptoms are giddiness, drowsiness, thirst, and dryness of the throat from suppression of saliva, wide dilation of both pupils, and delirium. There have been many cases of poisoning by eating the berries, either fresh or baked in pies, twenty instances being cited by Woodman and Tidy. Atropine is applied *to the eye* by surgeons to widen the opening of the pupil. It has been reported that the same application is sometimes made by ladies to increase the beauty of the eye.

Other symptoms to be noted are dryness and bright red color of the skin, with difficulty, in some cases, of passing urine. The delirium is frequently quite pronounced, and may lead to the case being taken for one of alcoholic intoxication, but the absence of the odor of alcohol in the breath will serve to make the distinction, and a certain test consists in the application of a little urine from the patient to the eye of a cat or dog, in which case, if atropine is present, it will cause a dilation of the pupil.

Treatment.—Give an emetic of ipecac or a teaspoonful of mustard in a cup of warm water, and follow it up with draughts of warm and strong tea, decoction of oak-bark, or tannin in any form. Finely powdered charcoal (see page 818) may also be given, and alcoholic stimulants or spirits of hartshorn with water, if required to relieve prostration. Teaspoonfuls of milk relieve the dryness of the mouth and throat.

Woody Nightshade.

Bitter-sweet, Dulcamara, or *Solanum Dulcamara.*

Black Nightshade.

Garden Nightshade, or *Solanum nigrum.*

Potato Apples.

Solanum Tuberosum, Fruit of the Potato.

As the poisonous elements of the above are similar, they will be treated of in a group.

Bittersweet is common in damp and sheltered places ; also cultivated in gardens. A shrubby plant, having small purple flowers and red berries. *Solanine* has been obtained from it, and it has feeble narcotic powers, but is only poisonous when taken in large quantities.

FIGURE 359.—Bittersweet.

The Black Nightshade is a flowering herb, bearing black berries, from which solanine has been extracted; but no other part of the plant is poisonous in small doses. The berries cannot be eaten with safety.

The fruit and seeds of the *Common Potato* contain a variable quantity of the alkaloid solanine, and are capable of poisoning to the same extent. Even fatal effects have occurred from eating them. The leaves and stalks have been found, though not invariably, to act as a poison. The same is true of the tuber when growing exposed and having a green skin. *Potatoes with one side green* had better be rejected. It is said that sprouting and decayed potatoes have sometimes been found to contain the active principle solanine. Solanine is not a stable compound, and it is probable

that either its formation or its preservation in the plant is due to conditions sometimes absent. The plants owing activity to solanine—potato, tomato, black nightshade, woody nightshade—possess a very variable power.

Symptoms.—The symptoms caused by the poisonous element of the above plants consist, in the case of Bittersweet or Black Nightshade, of vomiting, a quick and feeble pulse, difficult breathing, with perhaps restlessness, delirium or hallucinations, and dilatation of the pupils.

When unripe or unwholesome potatoes or potato-apples have been eaten, the first symptom commonly noticed is vomiting, then restlessness, a cold clammy skin, quick and difficult breathing, with an anxious countenance and a quick, feeble pulse. Diarrhœa very often sets in, the stools containing fragments of potato; and when the diarrhœa or vomiting lasts any considerable time, cramps, like those of cholera morbus, may appear. The face may, moreover, become swollen and red.

Treatment.—Emetics and purgatives, to get rid of the offending materials, with stimulants, in the shape of hot drinks, spirits, or hartshorn in water, to relieve depression.

Privet.

Privet. Ligustrum vulgare.—A shrub four to ten feet high; growing by fences and roadsides; sometimes used for hedges, bearing bitter-astringent leaves, pleasant-smelling, snow-white flowers, and sweetish-bitter, black berries, sometimes used for dyeing. The berries, leaves, and shoots act as narcotic and irritant poisons. There are reports of a considerable number of cases of poisoning of children by eating the berries,

Symptoms.—Vomiting and purging, followed, in severe cases, by insensibility and convulsions.

Treatment.—See page 818.

Oleander.

Nerium Oleander.—A common, cultivated, ornamental plant. The leaves, flowers, and bark are poisonous, especially the bark. The poisonous component is not volatile, belonging to the resins. Stupor, convulsions, and prostration are among the symptoms.

Treatment.—See page 818.

Poke.

Phytolacca decandra. Scoke. Garget.—A plant growing common, especially in newly cleared and uncultivated fields, reaching six or eight feet in height, flowering in racemes (July), with dark purple, shining berries. When the berries ripen, the stems (stalks) become purple. The juice of the berries is purplish-red. They have a sweetish, slightly acrid taste. The root is emetic, in doses of ten to thirty grains; in larger doses, poisonous. The berries and mature leaves in a less degree have the same effect. The young shoots are cooked and eaten without injury.

Symptoms.—An overdose of poke-berries will pretty surely cause profuse vomiting and diarrhœa, by means of which the drug will be got rid of. Muscular weakness, with some stupor, may follow, and a pricking and tingling of the entire surface of the body.

Treatment.—See page 818.

Spigelia.

Carolina Pink. *Spigelia Marilandica.*—Native to the Southern and Western States; growing in rich soils, on the borders of woods; flowering in June and July. It grows from eight to fifteen inches high, with several erect stems from one root, each stem supporting four to twelve showy flowers, carmine-colored without and orange-yellow within. The root is fibrous. The whole plant acts on the system, the root being the most active. It is used medicinally. In overdoses, it gives violent narcotic effects, vertigo, spasms, coma, dilated pupils.

Treatment.—See page 818.

Stramonium.

Datura stramonium. Thorn Apple. Jamestown Weed.—A vigorous annual, growing in rank soil, two to five feet high, with tooth-edged leaves, dark green on their upper surface; large, white solitary flowers; the fruit as large as a walnut, and coated with sharp spines. All parts of the plant, especially the fruit and seeds, are poisonous, owing to the presence of *daturine* or *atropine.* Children are frequently poisoned by eating thorn-apple seed.

Symptoms.—At first, and soon after the poison is taken, in the form of either the leaves or seeds, there is giddiness, with dimness

of sight, faintness, loss of sensibility of the skin, large pupils, a flushed countenance, and a slow, full pulse. The skin is sometimes quite red and hot, the expression wild and staring, and there

FIGURE 360.—Thorn Apple.

is incoherence of speech, although the disposition to talk is constant. There may also be hallucinations of the sense of sight, the person affected attempting to grasp at or drive away imaginary

FIGURE 361.—Virginia Creeper.

objects. There is a disposition to pick at the bed-clothing, and a constant tendency to loud laughter. The gait is staggering or there is entire inability to walk.

Treatment.—This is similar to that of poisoning by *Belladonna*, for which see pages 799 and 818.

Virginia Creeper.

American Ivy. Ampelopsis quinquefolia.—There are reports of a number of cases of poisoning of children by chewing the leaves of this plant. There was vomiting and purging, dilation of pupils, and collapse, with recovery in about four hours after treatment, with milk and stimulants.*

Yew.

Yew. Taxus baccata; variety, *Canadensis.* American Yew. Northern States and Alleghanies.—A low, straggling bush, with

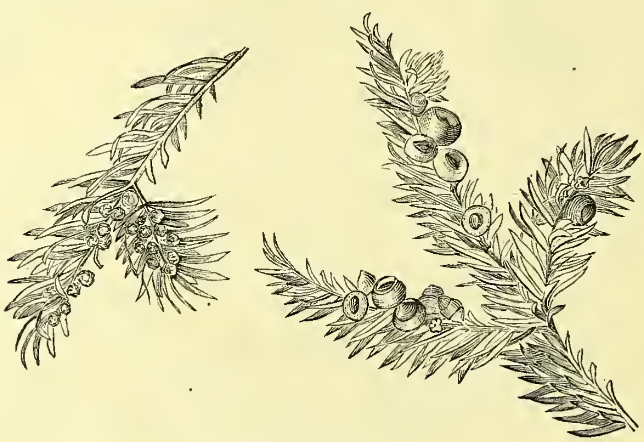


FIGURE 362.—American Yew.

red berries. Reported a narcotico-acrid poison, both in the berries and leaves. It is stated to be poisonous to cattle, not to sheep.

Pulsatilla.

Pulsatilla.—The American variety of Pulsatilla, or Field Anemone, is found, according to King, growing on dry, sandy soils in Minnesota and Missouri and Platte Rivers, westward, with pale, purple, cup-shaped flowers (which appear early in spring) and long, delicate, silken hairs on the leaves and stalks. It has a faint

---

* Phar. Jour., 1876, July, p. 80.

camphor-like smell, and a somewhat sweetish taste when dried. The fresh flowers and leaves are poisonous, acrid, and irritating, and when taken have produced nausea, vomiting, slimy diarrhœa, profuse sweating, increase of urinary flow, peculiar pains, and dimness of the eyes.

Treatment.—See page 818.

Laurel.

Mountain Laurel, Lambkill, Big-leaved Ivy, Calico-bush, or Sheep Laurel, are various names given to the *Kalmia latifolia.* It grows from four to eight feet high, has beautifully dark green leaves and handsome white flowers, tinted with red or pink, appearing in June or July. It frequents damp soils on rocky hills, and often forms dense thickets. Sheep are said to be killed by eating the leaves, while deer, goats, and partridges are not affected.

Although the Indians used to make a strong tea of laurel leaves for the purpose of suicide, it is not often that poisoning now occurs from them directly. It is said, however, that the flesh of partridges which have fed on laurel causes symptoms of poisoning, when eaten by some persons.

FIGURE 363.—Sheep Laurel.

Symptoms. — Sickness at the stomach, dimness of sight, headache, difficult breathing, and coldness of the skin and of the extremities.

Treatment.—An emetic of twenty grains of powdered ipecac, or a teaspoonful of mustard in a glass of warm water; mustard poultices to the spine, and, internally, brandy or other spirits.

7. Metallic and Other Poisons Liable to Occur in Food.

Lead in Potable Waters.

The accumulative effect of minute quantities of lead taken into the system every day has been described under the head of "Lead Poisoning by Working with Lead Paint or Metal." It is well established that the lead oxide (or oxy-hydrate) formed in the oxidation of a lead surface (as shown by the tarnish) is dissolved by pure water in a degree that renders the latter injurious or unsafe for human use. The quantity of lead oxide taken up by pure water is diminished by such access of air as will form the oxide into basic carbonate of lead, and is of course diminished when the water is not long in contact with the tarnished metal. Many spring and well waters, containing sulphates, etc., dissolve less of the lead than pure water, and some dissolve none at all; while other waters, especially those loaded with organic matter or effervescent with carbonic acid, are liable to dissolve more than pure water. It can be ascertained only by trial and analysis of the result that a given water is not contaminated by lead pipes. Prof. Chandler found 0.11 grain of lead in a gallon of Croton water that had stood six hours in a lead service pipe. Dr. Schweitzer, of Missouri, found 2.5 grains of lead per gallon in rain-water that had stood in lead pipes one month. S. Dana Hays called attention (Am. Chem., 1870, 163) to the excessive solution of lead in certain *metallic ice-pitchers*, namely: those of Britannia metal in double walls on the sides, and a copper bottom soldered on, the whole silver plated. The galvanic action between the metals causes the solder (two-thirds lead) to dissolve rapidly, so that the pitchers soon need to be repaired. After standing twenty-four hours in one of these pitchers, the water was found to contain 11.80 grains of lead to a gallon.

Cases of chronic poisoning are reported from use of water containing from 0.01 to 0.1 grain of lead per gallon. The majority of persons may use such waters without distinctive evidences of lead poisoning, but probably few persons could use them without injury.

Substitutes for Lead Pipe.—The tin-lined lead pipe, found to do good service, may be substituted for lead pipe, without danger. In some places the *galvanized* (*zinc-coated*) *iron pipe* has been used to avoid lead. The zinc coating corrodes rapidly to zinc oxide. This is liable, in many pipes, to be washed along and carried with the water into use. Some chemists have apprehended

great danger from this source. The zinc oxide is not dissolved by water in proportion greater than one to fifty thousand parts, as the writer has verified by determination. Zinc is not a cumulative poison, and there is little evidence of the occurrence of chronic poisoning among those who work in this metal. In view of these considerations, if the water be filtered (to insure absence of zinc oxide in powder), we do not deem the use of the zinc-washed pipe unsafe.

Lead and Copper Dissolved in Acidulated Beverages and Sealed Fruits.

Acid liquids dissolve lead, from the surface of lead vessels, by formation of soluble salts of lead, so that there is no limit to the concentration of the lead solution. Mildly acid drinks, so charged, become potent agents of chronic lead-poisoning; and vinegar, lemonade, acid wine, and cider may become so charged with the metal as to cause acute poisoning. Stevenson Macadam, of Edinburgh, found one-half grain of lead to the gallon in aërated water—"soda-water"—on sale. In the construction of *soda-fountains,* it is admitted by all, lead should nowhere be used so as to be in contact with the aërated water. *Copper* and tin-washed copper fountains are a frequent cause of contamination to "soda-water," charging the drink with copper-salt.* The first draught from a soda-fountain in the morning, bringing the acidulated water that has stood in copper-tanks or lead-pipes all night, is sometimes strongly metallic and astringent to the taste, even as disguised by the syrups. Lead tanks, pipes, spigots, and siphons are far too much used in handling and storing acid drinks and condiments. It is very common to find vinegar contaminated with lead. It should also be noted that white-lead paint, as in pails and other vessels, is acted upon by acid liquids with solution of the lead salt.

Acid fruits, put up in tinned cans, are liable to dissolve the lead of the solder, or even lead contained in the tin as an impurity. It is believed that lead palsy has originated in this manner.

Lead Enamelled Cooking Utensils.

Certain of the porcelain-lined cooking vessels are stated to contain lead, and, furthermore, that the lead is in an easily soluble condition. There could not be a more reprehensible use for lead. It is stated that the gray porcelain lining is, for the most part, free from lead; while the white lining is dangerous.

---

* See a series of articles in *New Remedies*, 1877.

Flour Poisoned with Lead from Mill-stones.

A few instances of this contamination of flour have been reported; the mill-stones having been repaired by filling cavities with metallic lead.

Poisonous Colors in Confectionery and Food.

Perhaps the most common of these is *chrome yellow* (lead chromate), having the cumulative poisonous character of lead-salts, and lesser poisonous properties common to chromates. All analysts of confectionery find this color frequently in candies. A few years since, Prussian physicians called attention to the increasing trade of dealers in lead and arsenic colors and colored papers for confectionery and toys. The wrapper of a chocolate-tablet was found to contain three grains of a lead compound; the wrapper of a bon-bon, one-and-a-half grains. In the Boston Board of Health Report for 1874, J. M. Merrick reports examination of a series of candies and lozenges colored with lead, copper, arsenic, and antimony salts, and concludes that, including aniline dyes (liable to be poisonous), poison colors are used in from one-third to one-half the confectionery on sale. In England, the present law for the suppression of adulterations is beginning to tell on the interests of the dealers and manufacturers of these articles. The French Sanitary Police publish a list of colors permitted to be used in candies and liquors; and these various harmless colors (all vegetable, except Prussian-blue) are now made of such unrivalled beauty that even the poor excuse of convenience cannot be urged for using poisonous metals.

Copper Poisoning of Pickles and Preserved Vegetables, and the Use of Copper Cooking Utensils.

The most common salt of copper, the sulphate, or "blue-vitriol," in doses of two to five grains, acts as a vigorous emetic, causing little prostration. If taken in larger doses, there is acute poisoning with pain in the bowels, violent vomiting and purging, jaundice, convulsions, and fatal result in many cases. Chronic poisoning with copper has long been recognized as occurring among coppersmiths, workers in malachite, etc., as well as from use of food contaminated with copper. The symptoms are described as embracing a constant metallic taste in the mouth, thirst, nausea, lassitude, jaundice, and other more variable effects. The number of authenticated cases of copper-poisoning seems to be considerably

smaller than those of lead-poisoning ; the symptoms, also, are less distinctive in the former than in the latter affection. In most cases, the system becomes habituated to small doses of copper. Many chemists at different periods have found traces of copper as a normal constituent of the human body, and of flour and other articles of vegetable food ; while other chemists have dissented from these conclusions. There is no doubt that chronic copper-poisoning does occur; but the question has been raised of late, what quantity of copper, daily taken, is enough to produce it, or to affect the system unfavorably ? Probably most medical men would hold that any quantity, which the chemist can detect, should be forbidden to enter into human food. But even as to more notable quantities, a singular division of opinion has lately appeared in England, as follows : *Green peas,* preserved in sealed tin-cans, mostly put up in France and consumed in great quantities in England, have been found to contain copper. The manufacturers state that they do add a minute portion of blue-vitriol, asserting that in this way only can they preserve the green color of the vegetable from fading ! Prof. Redwood and other chemists find no less than from one to two grains of copper sulphate to the can of eight or ten ounces of peas. Numerous prosecutions for the sale of the peas have taken place under the law for prevention of adulterations. And now two reputable and able chemists, after investigation, in a paper before the British Pharmaceutical Conference, conclude that the said quantity of copper in the peas is not injurious, being, as they claim, mostly discharged with the fæces. (Phar. Journ., Sept. 22, 1877.) But general opinion must agree that whatever tolerance the human body may have for continued administration of copper in appreciable quantities, such an imposition on the system is liable to vitiate the conditions of health, and must be condemned.

Pickles are often colored by copper. This occurs from cooking in vessels of copper or brass in domestic preparation, and by addition of a salt of copper in manufacture for sale. It may be that the copper serves as a coloring agent much beyond its direct coloring power, by acting as a mordant for the plant green. The custom of tampering with poisons in food for the sake of a shade of color, is both reckless and ridiculous. If *the people*, fully informed, would let it be known by those who cater to the public taste, that it is "the popular whim" to avoid preserved vegetables of a suspiciously bright green color, and to choose the paler shades, the absurd evil would very soon be abated. In this, as well as in many other things, a fully informed people may protect themselves without the help of the law. If, in this country, we are

not able to guard the purity and integrity of food by legal restrictions, as well as they do in Europe, we should be as well able to do the same thing in a better way, by the self-protective ability of well-apprized citizens.

Copper cooking utensils, those of brass included, are acted on by all *acidulous* liquids, by *fats* (especially when heated), by volatile oils and rancid oils, and by solution of common salt; in each case the material becoming contaminated with copper. Vessels of tinned copper, with the tin partly worn off, are often in use in the kitchen. Various cases of acute, and even fatal poisoning, in this way, are given, for example: a lady and daughter who died in twelve and thirteen hours after eating sauerkraut, kept in a copper vessel; and ten persons together, taken ill from eating of food cooked in a dirty copper dish.

Poisonous Chemicals in Sugars and Syrups.

Probably no article of food is looked upon with more distrust at the present time than table syrups, and the refined sugars of the market have also been the subject of suspicion. (1) It is known that syrups, perhaps yellow sugars, and certain candy-sugars, are sometimes made from starch by use of dilute sulphuric acid (oil of vitriol). The sugar so produced is itself glucose or grape-sugar—in alimentary value certainly not inferior to cane sugar, though of far less sweetening power; but the question is that of the sulphuric acid or some impurity or product of it remaining in the sugar. Prof. C. F. Chandler states that starch-sugar-syrup is made by only one or two establishments, who combine sugar-house syrup with glucose-syrup made from Indian corn-starch. Also that, in the service of the New York Health Board, he has examined a great variety of sugars sold at retail, and has never found an unwholesome specimen.

Prof. Kedzie, of the Michigan Board of Health (Annual Report, 1875), during the analysis of seventeen syrups, found three to contain free sulphuric acid, in proportions, respectively, of 80, 141, and 71 grains of the acid to the gallon of syrup. This is certainly a large quantity of free acid; we think it unusually large. It is from half a grain to one grain (pretty nearly) to a fluid ounce of syrup. Prof. Kedzie also found lime compounds in most of the samples; and he attaches considerable importance to the fact that in over half of them he found sulphate of iron in quantities from 25 to 38 grains to the gallon. One of these syrups was believed to have caused illness.

Now, free sulphuric acid is a decidedly objectionable impurity in syrups. It must be understood, however, that sulphuric acid, though held in dread as "oil of vitriol," is only a poison when it is free, and concentrated enough to corrode locally. Many of the salts formed by neutralizing the acid are natural articles of food, and no one objects to sulphates in well-water.

Iron is found in most table syrups, introduced by the rusting and abrasion of apparatus, and in glucose-syrups more abundantly by action of the acid liquid on iron vats and pipes. It is the iron which gives, with tea, the inky stain in so many syrups and yellow sugars—due to the tannic acid of the tea. This has been employed as a popular test for glucose; its only significance depending on the probability that glucose-syrup will contain more iron than sugar-house syrup. But sugar-house syrup contains more or less glucose, by change of cane-sugar during manufacture.

As sulphuric acid is often contaminated with arsenic, and in the manufacture of starch-sugar the arsenic would not be taken out in removing the sulphuric acid, it has been questioned if the sugar may not be left *contaminated with arsenic*. To answer this question, four syrups and ten sugars—collected by Mr. L. Rossiter, of Chicago (Lake Forest), Illinois—were examined, with the co-operation of the writer, for arsenic. Not a trace of arsenic was found; the method of analysis being one found capable of revealing the proportion of one grain of arsenic in 476 lbs. of sugar (Am. Jour. Phar., 1877, Oct., p. 478).

(2)—The question of the presence of lead in white sugars was more especially the object of the examination just mentioned, of the samples collected by Mr. Rossiter, who has written repeatedly in the Chicago daily papers, as to hurtful sugars. It is known that sugar of lead has been used in decoloring sugars, and fear has been expressed that, in this way, refined sugars may become contaminated with the lead. In the fourteen samples no lead was found; the analysis being competent to reveal one grain of lead in about ten pounds of sugar (*loc. cit.*).

In 1875 twenty specimens of grocers' sugars and syrups were examined during investigations in which the writer was engaged, and no hurtful metals were found (Am. Chem., vi., 43). It is stated that a very small quantity of tin salt is sometimes added in clarifying sugars; and analysts have frequently found tin in their examinations.

Injurious Flavoring Extracts.

Certain of these are manufactured from ethers of artificial formation. As such, a few of them represent the actual odor-giving substances of fruit and plants. Among these are ethyl butyrate—the fragrant constituent of the pine-apple; methyl salicylate—the chief part of natural wintergreen oil; and, very lately produced, benzoic aldehyde—the natural oil of bitter-almond. Also, vanillin—the flavor of vanilla, is now reproduced by acting on a product of the pine-tree. These products, then, if made free from impurities and if not presented in too concentrated a form, are as harmless as if obtained from the living plants they represent. On the other hand, various ethers—the acetates, formates, valerates, benzoates of ethyl, amyl, methyl, aldehyde, etc.—are mixed together in numberless different proportions, to simulate the flavors of pears, apples, peaches, strawberries, raspberries, and other fruits; and many of these mixtures, more or less dimly resembling the plant-flavors, but wholly foreign to them in composition, contain narcotic depressing and hurtful constituents. Not worthy the designation of artificial, they should be termed fictitious essences.

It was stated above that artificial *bitter-almond oil* is now made identical with the natural. The oil, as derived from the bitter-almond, cherry-laurel, peach, and other plants of the almond family, is formed (from amygdaline) along with hydrocyanic or prussic acid. In preparation of flavors, this deadly hydrocyanic acid should be, and often is, removed; also, being very volatile, it gradually evaporates away, and in cooking is wholly dissipated. But, from negligence of the manufacturer, and excessive use of the flavor, added after food is cooked, as in custards nearly or quite done, etc., cases of serious and even fatal poisoning have occurred. Cherry-laurel water, bitter-almond water, peach-pits and blossoms, have caused illness and death.

These flavors should be used sparingly, and added to food to be afterward cooked. If the flavoring essence contains hydrocyanic acid, its odor will be somewhat more oppressive and, in part, resembling that of cyanide of potassium. Also, a glass plate, wet with solution of nitrate of silver and laid upon the open mouth of the bottle will (after fifteen or twenty minutes) become coated with a white precipitate.

But the use of the bitter-almond flavor is beset with another danger; the substitution of *nitrobenzole*, or nitrobenzene, an intensely poisonous substance, having nearly the odor of bitter-

almond oil, though of wholly different composition and character. This substance, termed "oil of mirbane" and (improperly) "artificial oil of bitter-almond," is a transition-body in the manufacture of aniline from the benzene of coal-tar. It is the almond scent so common in cheap soaps. There have been rumors of its use in confectionery; it has been detected in alcoholic liquors; and, being cheap, it is liable to be applied by unscrupulous makers of almond flavors. Its effects do not appear directly after its administration, yet they come on suddenly with coma—almost like the "strange, lingering poisons" of poetry. Thus, a young man inadvertently sucked a little nitrobenzene into his mouth through a siphon and immediately spat it out. Drowsiness and coma came on in an hour and a half; convulsions in four hours and death in nine hours. Fatal poisoning has occurred by inhaling the condensed vapor from the breaking a large bottle while hoisting it from a ship.

There is no well-approved antidote.

8. Poisoning from Use of Insecticides and Vermin-Killers.

Of the poisons in use for destruction of pests of the animal kingdom, arsenic (ratsbane), strychnine, phosphorus, and corrosive sublimate are the most common. The well-known nature of these articles has been elsewhere referred to, and their antidotes will be found in the list at the close of this article.

Phosphorus Rat Paste generally contains about five per cent. of phosphorus, mixed with flour, sugar, oil, butter, and Prussian-blue. Some of them contain *arsenic.*

"Battle's Vermin-Killer" contains twenty-three per cent. of *strychnine,* mixed with sugar, flour, and Prussian-blue.

"Butler's Vermin Killer" contains five per cent. *strychnine,* with flour and soot.

"Gibson's Vermin-Killer" contains about one-half grain of *strychnine* in each powder.

"Gutmann's Mittel gegen Ungeziefer" is *phosphorus* paste, colored with red-lead and scented with anise oil.

"Kwizda's Rattengift" is a mixture of three parts of tallow and one part of powdered *nux vomica.*

Paris-Green.—The use of this substance for the destruction of the potato-beetle has reached such enormous proportions, without being known to have done any harm, that it may almost be regarded as a successful experiment on a large scale. It is estimated that over one hundred tons of the article have been sowed on the soil of Michigan in a single year. As the beetle steadily marches eastward, the demand for the arsenical green accom-

panies it. It is not comfortable to contemplate the distribution of so large a quantity of indestructible poison in the soil whence our food is derived. Fortunately, plants can be relied upon, as a rule, not to take from the soil any metals which can poison animals. And in this case very careful analysis of good chemists have failed to detect arsenic in plants growing in arsenical soil. Then comes the question of poisoning water supplies. Being practically insoluble in water, may not rains and currents collect and deposit the poison where it may do great harm? Fortunately, again, the soil can be depended on to fix and hold it, in the attenuated proportions of its distribution, and not to give it up again. The truth of this statement seems clearly established by experiments done by Prof. Kedzie of the Michigan Agricultural College (Michigan Board of Health Report, 1875, p. 13). Other authorities, also, decide that arsenic is held in the soil, being fixed by the iron oxide, as in the use of the hydrated oxide of iron as an antidote to hold arsenic insoluble in the stomach. [For composition and dangerous properties of paris-green, see Poisoning by Colored Fabrics, in this Article.]

White Hellebore, *Veratrum album*, the root of a European plant, is used to destroy insects preying upon useful plants, including those bearing small fruits. It contains the poisonous alkaloid, veratria. It is administered medicinally in doses from two to twenty grains; larger doses cause vomiting, purging, and prostration. No instances are known to the writer of injury from eating fruit sprinkled with it as an insecticide; nevertheless some care should be exercised in its use upon fruit bushes.

10. Poisoning by Phosphorus Matches.

Numerous cases of fatal poisoning of infants by sucking matches are recorded. Other cases occur of serious and fatal results, from the dropping of matches into cooking utensils and food.

Symptoms.—In acute phosphorus poisoning the symptoms do not transpire immediately, but after one or two hours, or even after a day or two, a burning pain in the stomach is gradually developed; there may be belching up of gas, which is phosphorescent in the dark and of garlic odor; sometimes vomiting and purging; with weak pulse, low temperature, great thirst, and dilated pupils, the intellect remaining clear. After apparent convalescence for several days, sudden and fatal relapse is common. The death of a child has occurred from sucking two matches.

Treatment.—There is no chemical antidote. Evacuate the

stomach by means of an emetic of mustard and warm water, or by ipecac, and then give calcined or carbonate of magnesia in tablespoonful doses, mixed with gruel; or a solution of baking soda in gruel. Oil and fatty matters are to be avoided.

11. Poisoning by Sausages, Smoked and Salt Meats, Salt Fish and Cheese.

Symptoms of poisoning have sometimes followed the eating of the above-named articles of food, and given origin to unfounded suspicions of their having been poisoned. It is now understood, however, that some animal substances containing albuminous (nitrogenous) elements may sometimes undergo a peculiar form of decomposition when kept for some time, and that some kind of poisonous principle may thereby be developed. Exactly what the nature of this poison is cannot yet be said.

Sausage-Poisoning.

In the case of sausage-poisoning, it has been found to be most common from those which have been insufficiently cooked, and in which unsuitable substances, like milk, flour, corn-meal, brains, too large lumps of fat, or onions have been used, and in which the sausage-meat has been cured in masses so large that the inner portion remains unaffected by the process of smoking. Indeed, it has been reported that in all cases the inner portion of the tainted sausage was the part at fault, and that those who partook only of the outer part were not affected. Without exception, the sausages have had a bad odor, a dirty, grayish color, and a soft consistence.

Symptoms.—The evidences of sausage-poisoning are rarely very rapid, occurring generally in from twelve to twenty-four hours. At first there is general discomfort, then nausea, a feeling of weight in the stomach, vomiting, and diarrhœa. Sometimes there are colicky pains, which may disappear and return some hours or days later. In other cases, disturbance of vision, difficulty in swallowing, and great muscular weakness and prostration are the symptoms complained of. Death occurs in some cases, and convalescence is likely to be slow.

Treatment.—A brisk emetic—like ipecac—and a purge to evacuate the bowels, are at first indicated. Stimulants, when there is much prostration, and other treatment to meet the symptoms which arise, will also be required, all of which can be determined only by a physician.

Poisonous Fish.

In the case of poisonous fish, it may be said that there is no sort which is essentially poisonous; but there are some species which, under certain circumstances, may become so. Among these are counted some varieties of sturgeon which have been preserved by salting. With some people certain kinds of shell-fish produce such disturbance of the system as to be rated as poisonous.

Symptoms.—In the case of salted fish, the symptoms, with the exception of vomiting, do not differ greatly from those of sausage-poisoning. In the case of unwholesome shell-fish, in addition to more or less disturbance of the digestive organs, there is commonly an intense eruption of nettle-rash.

Treatment.—This is essentially the same as directed for sausage-poisoning. The nettle-rash, which sometimes follows the eating of shell-fish, may be relieved somewhat by lotions of soda and water.

Poisonous Cheese.

Both in this country and in Europe instances of severe poisoning by eating cheese have repeatedly occurred, in most of which the strictest investigation has failed to reveal the poison. Cheese of qualities apparently excellent, and made by careful and scrupulous hands, has proved strangely hurtful. Absence of metallic and other known poisons has been proven. The poisoning of the milk from food eaten by the cow seems to be contradicted by the fact that the milk has caused no injury. It is believed (the most reasonable supposition) that the poison consists of subtile products of an unusual form of fermentation.

It is worthy of note that in most of these cases the cheese has been one of the soft kind and of domestic manufacture, which has been kept until it has become old and partly decomposed. It is also a fact that animals have eaten portions of the same cheeses without having suffered.

Symptoms.—Colicky pains, vomiting, diarrhœa, disgust at all kinds of food, dizziness, headache, disturbance of vision, great weariness, and muscular weakness.

Treatment.—The same as in the case of sausage-poisoning.

12. Accidental Poisoning by Articles Used in Medicine.

What to do in Cases of Acute Poisoning before the Physician takes Charge.

Acid, Hydrochloric (muriatic): Nitric (aqua fortis): Nitro-Hydrochloric: Sulphuric:	Give a heaping teaspoonful of soap (soft or hard; if hard, shaved fine) in a teacupful of water; then white of egg; then plenty of magnesia or chalk. If egg is not at hand, give milk. Do not use emetics or the stomach-pump.
Either of the above Acids *on the Surface of the Body*:	Apply solution of carbonate of sodium (baking soda or sal-soda), then oil. If soda is not at hand, apply soap dissolved in water.
Either of the above Acids *in the Eye*:	Wash the eye thoroughly with solution of carbonate of sodium in about 200 parts of water (only slightly alkaline).
Acid, Oxalic, or Oxalates:	Give prepared chalk, in water or milk enough to make a cream, abundantly. If the chalk is not at hand, scrape wall plaster very fine, and give this very freely. *Afterward*, if vomiting does not occur, give a teaspoonful of ground mustard in warm water as an emetic.
Acid, Carbolic (Phenol): Creosote:	Give white of eggs very abundantly. Then an emetic of mustard (a teaspoonful) and warm water. Then a mixture of magnesia and olive-oil. Give saccharate of lime as soon as it can be obtained.
Acid, Prussic (Hydrocyanic): Cyanide of Potassium: Oil of Bitter Almonds, Cherry-Laurel Water, Peach-Pits:	Dash cold water over the head, face, and back (even if convulsions have set in). Keep up the respiration if possible. Let the patient breathe ammonia, and give a little by the mouth (not too strong in either mode). Hold wetted chloride of lime near the nostrils. If it can be obtained, give a mixture of sulphate of iron (dissolved) and solution of subsulphate of iron with a little caustic alkali as soon as possible. (Ten grains of sulphate of iron dissolved in one fluid ounce of water, with one-half fluid drachm of solution of subsulphate of iron, and enough liquor sodæ to make a slight alkaline reaction. Give half the mixture in one dose.)
Arsenic and its Preparations: Paris-Green:	Give a teaspoonful of mustard in warm water or warm milk, and tickle the throat to excite vomiting. *Meantime* obtain as soon as possible the fresh precipitate of hydrated peroxide of iron (ferric hydrate), and give this in tablespoon doses repeatedly before or during intervals of vomiting or afterward. The precipitate can be made by mixing muriated tincture of iron (tincture of chloride) or Monsell's solution (subsulphate) of iron with ammonia or solution of any carbonate of soda (sal-soda or baking soda). The precipitate can be washed and drained by pressure in a handkerchief held as a strainer.

Poison	Antidote
AMMONIA, CAUSTIC: POTASSA, CAUSTIC: SODA, CAUSTIC: Lye of Wood Ashes, Quicklime.	Give vinegar, two or three tablespoonfuls, in as much again water, giving enough to neutralize the alkali. Lemon-juice may be given instead of the whole or a part of the vinegar. Then at once give olive-oil or milk. Do not give emetics or use the stomach-pump.
COPPER COMPOUNDS: Blue Vitriol, Verdigris. MERCURY COMPOUNDS: Corrosive Sublimate, White Precipitate, Red Precipitate, Vermilion. ZINC COMPOUNDS: White Vitriol.	Give white of egg very abundantly; then warm water and a teaspoonful or more of ground mustard, to excite vomiting. After vomiting, give white of egg and milk. If egg is not at hand, give a batter of wheat flour in milk.
IODINE: Tincture or Solution.	Give fresh paste of starch freely. Paste of flour is next best. Then give a teaspoonful of mustard and warm water, and excite vomiting.
ANTIMONY, TARTRATED: (Tartar Emetic.)	Excite or facilitate vomiting by much warm water and tickling the throat. Give strong tea or decoction of cinchona bark.
LEAD COMPOUNDS: Sugar of Lead, White Lead, Litharge, Goulard's Solution. BARIUM COMPOUNDS:	Give sulphate of magnesium (Epsom salt), an ounce or a little more, dissolved in water. Excite vomiting at once by warm water, a teaspoonful of mustard, tickling the throat. If sulphate of zinc is at hand, give it, ten to thirty grains, instead of the mustard, as an emetic.
SILVER NITRATE: (Lunar Caustic.)	Give a teaspoonful of common salt in a teacupful of water. Give white of egg freely. Excite vomiting by warm water, a teaspoonful of mustard, and tickling the throat.
CANTHARIDES PREPARATIONS: (Spanish Fly.)	Excite vomiting, giving warm water (with flaxseed or wheat flour gruel as soon as obtained) and tickling the throat.
COTTON ROOT, and its Preparations: ERGOT, and its Preparations:	Excite vomiting, giving a teaspoonful of mustard with much warm water.
OIL, CROTON: PENNYROYAL: SAVIN: TANSY:	Give milk abundantly. Excite vomiting by warm water and tickling the throat.
ATROPINE: BELLADONNA (Nightshade): COLCHICUM: DIGITALIS (Foxglove): HEMLOCK (Conium): HENBANE (Hyoscyamus): STRAMONIUM (Thornapple): VERATRUM VIRIDE (Hellebore):	Excite vomiting by warm water, a teaspoonful of ground mustard, and tickling the throat. Meantime very fine powdered fresh charcoal may be given. (May be powdered by pounding it enveloped in a handkerchief). After vomiting (or before, if long delayed), give much strong tea.
CASTOR-OIL BEANS: COCCULUS INDICUS: NUX VOMICA: OLEANDER: PAKE: PRIVET: PULSATILLA: SPIGELIA: STRYCHNIA: WHITE HELLEBORE:	Give very finely powdered fresh charcoal largely (quickly pounding coal from a wood fire) as soon as possible; excite vomiting by warm water, a teaspoonful of ground mustard, and tickling the throat; then give more charcoal and strong tea. Repeat the vomiting.

LAUDANUM: OPIUM: MORPHINE: Soothing Syrups:	Give very finely powdered charcoal (obtained as above); excite thorough vomiting. (as above), and repeat the charcoal with strong tea and the vomiting. The sulphate of zinc, ten to thirty grains, may be given instead of the mustard or in its failure. Rouse the patient by frequent walking, and by ammonia to the nostrils, and frictions with camphor.
CHLORAL HYDRATE:	Cause vomiting by warm water, a teaspoonful of mustard, or fifteen to twenty grains of sulphate of zinc, repeated if necessary, and tickling the throat. Give tea or coffee.

ALBERT B. PRESCOTT, M.D.

P6

18